

# PLANT LIFE

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AMARYLLIS  
YEAR BOOK

1976



Alstroemeria Hybrid  
'Walter Fleming'

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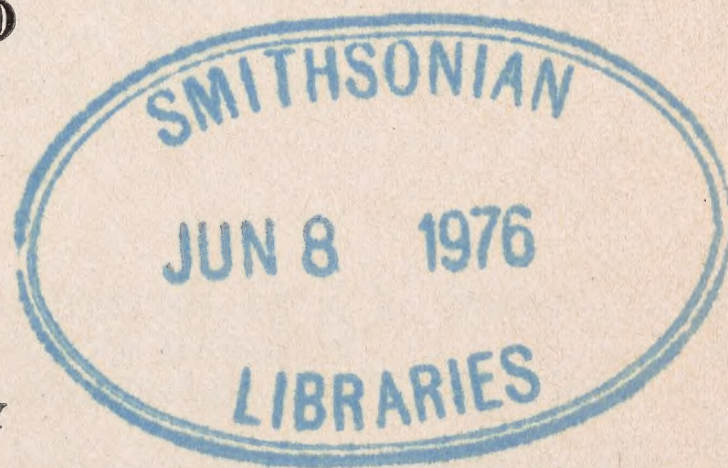
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1976



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**PESTICIDES: AN AUTO-TUTORIAL APPROACH**, by George W. Ware. W. H. Freeman & Co., 660 Market St., San Francisco, Calif. 94104. 1975. Pp. i-xv + 191. Illus. \$5.95.—This text deals not only with pesticides, but also with other uses of chemicals, and should be entitled, **PESTICIDES, GROWTH REGULATORS, DEFOLIANTS AND DESICCANTS**. It is described by the author as a self-instructional manual on pesticide application, for both private and commercial agricultural chemical fieldmen and structural pest control operators; and advanced high school students, college students, and others concerned with pesticides. The sections of the book are concerned with vocabulary and basic chemistry and formulations of **pesticides**:—insecticides; herbicides; fungicides; and bactericides; nematocides and rodenticides. In addition to the destruction of pests, chemicals are to be applied for other purposes: **plant growth regulators**; **defoliants**; and **desiccants**. Then follow sections on pesticides and the laws; safe handling and use of pesticides; and toxicity of pesticides. The book is completed with a final examination, glossary, bibliography and index. Very highly recommended to all working with pesticides, growth regulators, defoliants and desiccants.

**GLIMPSES IN PLANT RESEARCH, VOL. TWO: STUDIES IN PLANT BIOLOGY—A PALYNOLOGICAL APPROACH**, by P. K. K. Nair. Vikas Publishing House. Delhi. 1974. Imported by International Scholarly Book Services, P. O. Box 4347, Portland, Oregon 97208. This volume contains seven stimulating research papers by Dr. P. K. K. Nair of the National Botanic Gardens, Lucknow, who is an authority on palnology in relation to the evolution of plants. Five of the papers are on the subject of palnology, and two about plant morphology and evolution. The text is amply illustrated with line drawings, and in addition, photomicrographs of prepared pollen grains are presented in 12 plates, including a total of 86 figures to illustrate the article on Indian vegetable crops. This volume is highly recommended to all interested in palnology and evolution theory.

**PLANT PHYSIOLOGY**, by Dieter Hess. Springer-Verlag New York, Inc., 175 5th Av., New York. 1975. Pp. xiv + 333. Illus. Paperback \$14.80.—Subtitled, "**Molecular, biochemical, and physiological fundamentals of metabolism and development**", this forward-looking text "attempts to provide an introduction to the metabolic and developmental physiology of higher plants from a molecular biological point of view." The chapters are devoted to control of character formation by nucleic acids; photosynthesis; carbohydrates; biological oxidation; fats; terpenoids; phenols; amino acids; porphyrins; cell division, differentiation; gene activity as principle of differentiation; regulation; polarity and unequal cell division as fundamental of differentiation; cell elongation; the formation of seeds and fruits; germination; the vascular system and flower formation. Very highly recommended first of all to beginners in the study of plant physiology, but more advanced students can benefit from the message conveyed.

**POLLEN**, by R. G. Stanley and H. F. Linskens. Springer-Verlag New York, Inc., 175 5th Av., New York 10010. 1974. Pp. 307. Illus. \$24.60.—Subtitled, "**BIOLOGY, BIOCHEMISTRY AND MANAGEMENT**", this attractive text focuses upon pollen biology and chemistry and attempts to integrate these facts with management practices involved in pollen applications. The biological considerations are taken up in the **first section: Biology of Pollen**.—development, wall formation, dehiscence, size and distribution. The second section is concerned with **Management of Pollen**.—collection and uses; storage; viability tests; and nutritive role. The **biochemistry of pollen** is taken up in the third section,—general chemistry; carbohydrate and cell walls; organic acids; amino acids and proteins; pollinosis; nucleic acids; enzymes and cofactors; pollen pigments; and growth regulators. Very highly recommended to all interested in the biology and chemistry of pollens.

**TROPICAL ECOLOGICAL SYSTEMS: TRENDS IN TERRESTRIAL AND AQUATIC RESEARCH** (Vol. 11. Ecological Studies), edited by Frank B. Golley and Ernesto Medina. Springer-Verlag New York, Inc., 175 5th Ave., New York 10010. 1975. Pp. xiii + 398. Illus. \$24.80.—This volume contains contributions from various authorities who presented papers at the meeting on **tropical ecology** at New Delhi, India in 1971. The topics covered include physiological ecology; dynamics of populations; interaction between species; tropical forest analyses; savannas; tropical water bodies; island ecosystem; and applications. An index completes the volume. Very highly recommended to all interested in tropical ecology.

**EPIDEMICS OF PLANT DISEASES: MATHEMATICAL ANALYSES AND MODELING** (Ecological studies Vol. 13), edited by Juergen Kranz. Springer-Verlag New York, Inc., 175 5th Ave., New York 10010. 1974. Pp. x + 170. Illus. \$24.60.—In the introduction the editor, Dr. Kranz, points out that the objective of our study of epidemiology is to provide plant pathologists with refined and deepened knowledge of the behavior of diseases in the field. In the text that follows, he assesses the role and scope of mathematical analyses and model-making in epidemiology. Dr. Mogk discusses automatic data processing in the study of epidemics; Drs. Butt and Royle explain multiple regression analyses in the epidemiology of plant diseases; Drs. Jowett, Browning and Haning report on non-linear disease progress curves, and Dr. Waggoner discusses simulated epidemics. There are references following each of the contributions. A subject index completes the volume. Very highly recommended to all interested in plant diseases.

**PLANT MINERAL NUTRITION**, by E. J. Hewitt and T. A. Smith. John Wiley & Sons, 605 3rd Av., New York 10016, 1974. Pp. 298. Illus.—This outstanding new text on mineral nutrition in plants will be welcomed. After considering the history and principles of plant nutrition, and experimental methods for the investigation of plant nutrient requirements, the various aspects of subject are discussed in detail: mineral absorption in plants; soil problems and diagnostic aspects of mineral nutrition; the effects of mineral nutrients on growth and plant composition; inorganic nitrogen metabolism; and the functions and metabolism of the elements. An index completes the volume. This refreshing new outlook on the subject of plant mineral nutrition is to be commended. Very highly recommended to all interested in plant mineral nutrition.

**ION TRANSPORT AND CELL STRUCTURE IN PLANTS**, by David Clarkson. Halstead Press, a Division of John Wiley & Sons, 605 3rd Av., New York 10016. 1974. Pp. xi + 350. Illus. \$22.50.—This refreshing new text introduces the undergraduate student and other interested persons to the fundamentals of mineral nutrition. The book is in two parts. The first six chapters are devoted to the principles of mineral nutrition at the cellular level, drawing on a range of plant and animal biology, but as each new principle or experimental measurement is introduced, it is referred to the alga, **Hydrodictyon africanum**, which is used as a test case and model system. The second part (five chapters) is devoted to higher plants, particularly with ion transport by plant roots. Thus the level of inquiry moves from single cells through whole organs, and complete plants. Author and subject indices complete the volume. Very highly recommended to all interested in plant nutrition.

**PLANT LIFE LIBRARY**—continued on page 10.

PLANT LIFE, VOL. 32, NO. 1, January, 1976

# **AMARYLLIS**

## **YEAR BOOK**

### **1976**

Year Book of  
The American Amaryllis Society  
43rd Issue

GENERAL AMARYLLID EDITION

EDITED BY  
HAMILTON P. TRAUB  
THOMAS W. WHITAKER  
HAROLD N. MOLDENKE

THE AMERICAN PLANT LIFE SOCIETY  
Box 150, La Jolla, California 92038

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For the roster of the general officers of the Society, the reader is referred to the inside front cover of this volume.

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*Box 150, La Jolla, Calif. 92038*

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(AMERICAN AMARYLLIS SOCIETY, continued on page 129.)

## PREFACE

The beautiful cover design by Prof. Penrith B. Goff, pictures the *Alstroemeria* hybrid, 'Walter Fleming' which again brings to our attention the fact that these wonderful plants with cut-flower possibilities are still being neglected in spite of the fact that the writer and others, particularly the late Harry L. Stinson, have attempted to arouse interest in them since 1934. The flowers are outstandingly beautiful and very long lasting as cut flowers, and sooner or later these facts will be appreciated. Our new Chairman of the *Alstroemeria* Committee, Mr. Donald D. Duncan, proposes to do all in his power to change the outlook on the *Alstroemerias*.

This 43rd issue of the AMARYLLIS YEAR BOOK is dedicated to Mr. Floor Barnhoorn, of Maraisburg, Transvaal, Republic of South Africa, who has been engaged in the plant nursery business since childhood in the Netherlands, where his particular hobby had been the breeding of Hybrid *Amaryllis*. After World War II, in 1948, he emigrated to South Africa, and as a co-founder of the Harry Deleeuw Co., Ltd., nursery firm, he again made hybrid *Amaryllis* breeding his particular interest. Through the years since 1948, he developed the outstanding "Hadeco" *Amaryllis* hybrids which are marketed world-wide in the wholesale trade, and are appreciated by the numerous *Amaryllis* enthusiasts who buy the bulbs over the counter from the local plant dealers. Mr. Barnhoorn contributes an interesting autobiography to the present issue, and one of his sons, Mr. F. Barnhoorn, Jr., details the method of *Amaryllis* breeding followed by his father, and his sons.

There are other articles on *Amaryllis* in the present edition. Mr. Doran, Chairman of the *Amaryllis* Committee, contributes an article on interesting new *Amaryllis* species and their hybrids. Dr. Flory and his associates, present papers on *Amaryllis caupolicanaensis* and *Amaryllis belladonna* L. Dr. Cage, describes his *code system* for plant breeders which should appeal to the other plant breeders. Mr. Rogers, Vice-Pres. Northwest Region, explains his program for breeding fragrant *Amaryllis*. Mr. Blossfeld in Brasil, who is busy writing his two-volume work on the *Gardening in Brasil*, took time out to write on *Amaryllis calyptrata*. Dr. Whitaker, your Secretary, gives a survey on potting mixtures for *Amaryllids*; and Dr. Cage supplies instructions to make *Amaryllis* culture easy. Mr. Robers writes about his experiments with the storage of *Amaryllis* seeds.

There are various articles on other *Amaryllids*. Drs. Flory and Flagg write about the origin of three Texas *Zephyranthes* species. Dr. Howard reports on his *Zephyranthes* breeding project. Mrs. Wilson, Chairman of the *Zephyrantheae* Committee, presents a most interesting report. Mr. Bennett favors us with a brief report on *Clivia* breeding. Dr. Flory and his associates report on *Zephyranthes bifolia*. Mr. Buck, Chairman of the *Hemerocallis* Committee, reports for the years 1974 and 1975. Mr. Duncan, Chairman of the *Alstroemeria* Committee, presents his first report on successful *Alstroemeria* culture. Mr. Hannibal

writes about *Crinum* breeding.

In the General Plant Section, Dr. Zoellner and his student, contribute a report on *Miersia*. Mr. Hannibal gives a report on *Leucocrinum montanum*.

There are other contributions—on Amaryllis exhibitions in Texas, Louisiana, Alabama and California, and articles on other topics as shown by the Table of Contents.

Contributors to the 1977 issue of the AMARYLLIS YEAR BOOK are requested to send their articles by August 1, 1976, in order to insure earlier publication of this edition. Unless articles are received on time, publication will again be delayed to June or July or even later as with some issues in the past. Your cooperation toward earlier publication will be greatly appreciated. *Those having color slides or transparencies which they wish to use as the basis of illustrations are requested to have black-and-white prints made, and to submit these with their articles.*

December 15, 1975,  
2678 Prestwick Court,  
La Jolla, California 92037

Hamilton P. Traub  
Thomas W. Whitaker  
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#### PLANT LIFE LIBRARY—continued from page [6].

**PLANT ANATOMY**, by Forrest F. Stevenson and Thomas R. Mertens. John Wiley & Sons, 605 3rd Av., New York 10016. 1976. Pp. 1-xvii + 188. Illus. Paperback \$4.95.—This **program** book of questions and answers deals with the anatomy of flowering plants. It begins with a discussion of the nature of **plant cells** and continues with the study of **primary and secondary plant tissues** which are components of **plant organs**—roots, stems, leaves and flower parts. This program book is “self contained and provides answers for all the questions which it asks.” A selection of biology and botany textbooks is provided in which the answers to the questions asked may be conveniently found. This novel method of self-education is worthy of consideration, and is recommended to all students in plant anatomy.

**AIMS AND METHODS OF VEGETATION ECOLOGY**, by Dieter Mueller-Dombois and Heinz Ellenberg. John Wiley & Sons, 605 3rd Av., New York 10016. 1974. Pp. xi + 547. Illus.—This outstanding new text should set a landmark for its authors aim to reconcile the objectives and methods of the American and European schools of vegetation ecology. In Part I (General), the objective is to present a general background for an insight into **Vegetation Ecology**, and to provide the background for an understanding of the current trends in vegetation ecology, plant community hypotheses, and also to explain sampling methods in vegetation ecology. In Part II (Vegetation Analysis in the Field), the aims and methods of American and European workers in vegetation ecology are synthesized. This book thus sets a landmark, and is very highly recommended to all interested in ecology.

**ENVIRONMENT AND PLANT ECOLOGY**, by John R. Etherington and W. Armstrong. John Wiley & Sons, 605 3rd Av., New York 10016. 1975. Pp. i-xii + 347. Illus.—This text is concerned with the relationship between environment and plant physiological functioning, and with attempts to analyze the integrated operation of the ecosystem in terms

#### PLANT LIFE LIBRARY—continued on page 26.

DEDICATED TO  
FLOOR BARNHOORN



HERBERT MEDALIST—FLOOR BARNHOORN

## FLOOR BARNHOORN

## AN AUTOBIOGRAPHY

I was born at Noordwijk, Holland on 3rd October, 1911. Noordwijk is the hometown of the Barnhoorn family, where the name has been known since the 16th century. It is a seaside holiday town on the North Sea. Quite a few inhabitants were engaged in North Sea fishing. The Barnhoorns, however, were never a seagoing family, but always farmers and bulb growers. Noordwijk is about 4 miles from the famous "Keukenhof" at Lisse, the centre of the Bulb District.

My schooling began on 1st May, 1917, and ended on 30th April, 1924. In 1924 the family moved to Sassenheim, another Bulb District town, and times were such, that every able-bodied boy had to look for a living as early as possible. Although my parents would gladly have worked still harder, to enable me to become a teacher or a tradesman and thereby obtain greater security than they had, but I insisted on a career in flower bulbs. The work in the fields during the day was soon followed by evening classes, when I found out the hard way, that field work in winter was not something to look forward to for the rest of your life. I wanted something better.

After four years of work in the field and the sheds. I got "promoted" to office work and became assistant to the buyer. This appeared to be something that came naturally to me and when I was 18 I got an appointment as a full-fledged buyer. To enable me to sign valid contracts as a minor, I received special dispensation.

My career as a buyer lasted till 1932, interrupted by six months' training in the Army Medical Corps. The Great Depression brought an end to buying flower bulbs and I became engaged in the wholesale cut flower trade, an experience I have never regretted.

In 1935 I came back into the world of flower bulbs and till 1937 I travelled to England and the United States, selling bulbs.

In 1938 I started my own business as a commission agent in flower bulbs. My experience as a buyer came in handy and my business was an immediate success, but came to an abrupt end when the Second World War broke out and I was called to serve. After the collapse of the Dutch Army under the German onslaught in May 1940, I, like so many people in the bulb business had to muddle through. My marriage to Trijntje Buijs in 1942 and the birth of our first son in 1943, did not make it any easier to keep to my trade.

I added vegetable seeds, peas and beans to my dwindling trade in flower bulbs so as to be able to provide for my family. As the Germans, of course, wanted as many food crops grown in the occupied territories as possible, there was not much restriction on this kind of trade. The seeds were sold to farmers under contract. The evasion of "export" to Hitler's Reich was a sport in itself in those war days and my family never had to resort to tulip bulbs and sugar beets for food as so many others had to do.

After the war, I saw emigration to a Southern Hemisphere country as my best chance to start my own Bulb Farm. My choice fell on South Africa, the natural habitat of many bulbous plants.

As long as I have been engaged with flower bulbs, the growing and developing of *Amaryllis* has been my particular hobby and when I emigrated to South Africa I could make my hobby part—and an ever-growing part—of my business. This was in April, 1948.

In South Africa I started with three partners (two of them “Sleeping” partners). Mr. Harry Deleeuw took the administrative burden, while I was responsible for the nursery and the production planning, with Mr. Pieter Overvliet, who is at present my co-director, as assistant. Our Company was registered as Harry Deleeuw Company (Pty) Limited.

The first *Amaryllis* were imported from Holland in November, 1948, and that same year some wild growing *Amaryllis* were obtained in South Africa. According to Traub (Plant Life 17: 55. 1961; 19: 57. 1963) these have been named *Amaryllis* x *mostertii* Traub and appear to be hybrids between the American Belladonna, *Amaryllis belladonna* L. (syn.—*Hippeastrum equestre* Herb.), and another species of the subgenus *Omphalissa*, plus *Amaryllis reginae* L. (syn.—*Hippeastrum reginae* Herb.), species native to the West Indies and South America. These should not be confused with the Cape Belladonna, *Brunsvigia rosea* (Lam.) Hann. (syn.—*Amaryllis rosea* Lam.; *Amaryllis belladonna* Herb. non L.) which is native to South Africa. *Amaryllis* x *mostertii* Traub apparently was introduced into India, South Africa and other parts of Africa by early colonial officials and their families and settlers and escaped from cultivation into the wild. The feral South African form reported by Mr. Mostert was collected in the vicinity of Balfour, Transvaal, Republic of Africa.

The intention was to get hybrids that were at the same time free flowering, early flowering, fast multipliers and with a good resistance to virus. These had to be hybrids that could be cultivated vegetatively in large quantities and could be offered to the public at reasonable prices.

A mass-hybridization program was set up and each bulb with its offshoots kept separate from the start, so that the first flower immediately gave an idea of the value of the clone. In some colors the ideal was reached quickly, but in colors like pink, white and mahogany the results did not come so fast. By now, pink hybrids have been developed that are real break-throughs in that color. They are no longer actually white with some pink, but real pink in various shades.

Also in white a few clones have been developed and are sold in fair quantities. Good mahogany clones are coming on, but cannot be offered in large quantities yet.

Every clone is tried out for at least five years. Trial bulbs are grown in pots under circumstances imitating conditions in the Northern Hemisphere: so that their value as potplants may be judged. Trials are brought to flower in October/December and January and at present

also in March/April. Some bulbs are also tried out in the Northern Hemisphere itself and only when all trials have been satisfactory is the clone introduced into the market.

Fellow-growers in Holland made the remark, that the HADECO Amaryllis was the best advertisement they could wish for, because of its good and fast flowering properties in the season when Dutch grown Amaryllis are offered for sale; they stimulate the sale of the later flowering Dutch Amaryllis.

Production and sales of Amaryllis worldwide has been quadrupled in the past five years, so there seems to be some truth in the above remark. Anyway, the laudatory letters from buyers in some 15 countries show that HADECO Amaryllis give satisfaction. Harry Deleeuw Company can barely cope with the ever growing demand.

Amaryllis are grown on five different farms to spread labor as well as weather risks. To utilise the lands, sheds, temperature rooms and other equipment for Amaryllis only, would, of course, make the product far too expensive,—for the Amaryllis crop only, 100,000 bulb trays are needed, just as an example—many other products are grown to get full utilization of the facilities. Important crops are Tulips, Daffodils and Ranunculus, the latter developed in a HADECO strain, that has in its own right conquered as good a place in the international market as the HADECO Amaryllis and is next to it and practically equal in commercial importance.

Daffodils and Narcisses are another Barnhoorn hobby. Together with Tulips and Hyacinths temperature treatments for these bulbs have been developed that make it possible to have them in flower normally, even in the hottest parts of South Africa.

Mr. Harry Deleeuw, the last of the original partners, left the Company in 1961. In the meantime, my three sons, Floris (32), Daniel (29) and Andre (24) have entered the Board of Harry Deleeuw Company, taking an active part in further developments.

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### OBITUARY—HARRY L. STINSON

[The following obituary notice appeared in a local Seattle, Washington newspaper on January 4, 1961.\*]

Funeral services for Harry L. Stinson, 71, who taught 33 years in the Seattle Public Schools, will be at 1 o'clock tomorrow in the Washington Memorial Funeral Home. Cremation will follow.

Mr. Stinson died in a hospital, Monday, after a long illness. He taught manual training at Edison Technical School before his retire-

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\* Kindly furnished by Donald D. Duncan.

ment in the late 1940's. Earlier he taught at Cleveland and Broadway High Schools. He also taught in elementary and junior high schools here.

A native of Denver, Mr. Stinson spent part of his early life in the Walla Walla area. He was a Navy veteran of the First World War and a graduate of the University of Washington.

Survivors are his wife, *Marian*, at the home, 3723 S. 154th St.; a daughter, *Mrs. R. Walter Johnson*, Seattle; three brothers, *Elton*, of San Jose, Calif., *Earl*, of Dowd, Iowa, and *Joe Stinson*, Oakland, Calif.; a sister, *Mrs. Leanore Sanderson*, Pleasant Hills, Calif., and two grandchildren.

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### IN MEMORIAM—HARRY L. STINSON, 1890-1961

The other night it was my pleasure to spend an evening with the wife and the daughter of Harry L. Stinson. Mr. Stinson, who for years was the driving force behind the *Alstroemeria* section of the



Fig. 2. Harry L. Stinson in his *Alstroemeria* garden.

*Amaryllis* Society, died in January of 1961. Unfortunately I never had the opportunity to meet him but I had heard a great deal about him not only from people in the Seattle area but from as far away as England.

With a bit of luck I was able to discover that his daughter and family were living in Tacoma, Washington. I phoned her and introduced myself and explained that I would like very much to talk with her. Not only was she surprised that I had been able to locate her after all these years but she said she would be happy to meet and talk with me.

Several nights later I went to Mr. and Mrs. Johnston's home in Tacoma and was delighted to find that Mrs. Stinson, who is now living with her sister, was able to join us.

It was a most enjoyable evening. Many wonderful stories were told about the days when Mr. Stinson grew and sold his "Alstroms" and Mrs. Stinson, active in Garden Clubs and flower arranging, would make corsages of *Alstroemeria* blossoms for the ladies who came to visit, see, and buy the beautiful Alstroemerias. They had a few slides of the Alstroemerias, and some showing Mr. and Mrs. Stinson harvesting the flowers and tubers in the field.

After Mr. Stinson's death, most of his papers and translations were taken to the University of Washington library. I spent hours in the library and placed many phone calls trying to find his works. Everyone was most helpful but no one was able to find a trace of them. What a shame that all of his works were lost.

When the family moved from the house where Mr. Stinson had his garden of Alstroemerias, no attempt was made to move any of the plants, so they were all lost. It is unfortunate that there was no one at that time to carry on his work or save his collection of plants.—  
*Donald D. Duncan*

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## IN MEMORIAM—SYDNEY PERCY-LANCASTER, 1886-1972

DR. PRAKASH NARAIN,  
*National Botanic Gardens, Lucknow, India*

It is sad to inform the members of the American Plant Life Society that Sydney Percy-Lancaster, the noted horticulturist died May 9, 1972, at 1:30 a.m. at Delhi.

In 1971 he was hospitalized at Lucknow and then transferred to Dehradun and finally brought to New Delhi for treatment. The long illness of Mr. Percy-Lancaster at an advanced age led to many complications which weakened him very much. He remained in a coma for long time before he died.

It is worth recalling that after his retirement as Secretary of the Royal Agri-, Horticultural Society, Alipore, Calcutta, he spent a major period at the National Botanic Gardens, Lucknow. During this stay, he published several popular articles and bulletins on several aspects of gardening and hybridization techniques on various ornamental plants grown in present day gardens. He gave several broadcasts, lectures and popular talks to gardening clubs, schools and other institutions.

Aside from being a great horticulturist, Mr. Percy-Lancaster was also known as a poet, who composed a large number of poems, dedicated to his friends.

The sad demise of Mr. Percy-Lancaster has shocked all of us. We extend our condolences to his family, and pray God may provide rest to the departed soul.

### EDITORIAL NOTE

Mr. Sydney Percy-Lancaster received the WILLIAM HERBERT MEDAL in 1939 for his important contributions toward the advancement of the amaryllids. The readers are referred to *Herbertia*, Vol. 6. 1939, pp. 40-43, with portrait, for a brief autobiography.

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## THE SYDNEY PERCY-LANCASTER MEMORIAL SOCIETY

DR. T. M. KHOSHOO, *Director,*  
*National Botanic Gardens, Lucknow, India*

(Under date of July 21, 1975, Dr. T. N. Khoshoo sent the following tribute to the late Sydney Percy-Lancaster, born July 19, 1886, died May 9, 1972. He also sent a prospectus of the new Sydney Percy-Lancaster Memorial Society which will sponsor an annual lecture by an eminent Indian scientist in the field of ornamental horticulture at the National Botanic Gardens, Lucknow, and other activities connected with ornamental horticulture.—*Editor*)

(1) *The late Mr. S. Percy-Lancaster:* He was a personal friend

of mine and I had the honour to write about him in the Indian Horticulture [see following article.] He left NBG for some time to join Indian Botanic Garden, Calcutta, but he returned soon to Lucknow having shattered his health while at Calcutta. He had a paralytic stroke and passed away on May 9, 1972 at 1:30 A.M. at Delhi. He was cremated the same day and, as per his wishes, his ashes were sprinkled in our Garden (NBG). Between then and now, there were many changes here, and I was awaiting a suitable opportunity to organise a Sydney Percy-Lancaster Memorial Society. [This Society has now been organized.]

(2) Based on the collections that the late Mr. Percy-Lancaster made, I and my pupils [Drs. Iva Guha (nee I. Mukherjee), S. N. Raina, Prakash Narain and S. N. Zadoo] have worked on bulbous (using the word not in strict botanical sense) plants and accordingly we have studied *Canna*, *Zephyranthes*, *Crinum*, *Gloriosa*, *Amaryllis*, *Hemerocallis*, etc. and so far four Ph.Ds. have been granted and a number of papers published in national and international journals [136 articles].

(3) Having been inspired by the work of the late Mr. S. Percy-Lancaster, I thought I could complete the picture from the genetical angle. That this work has been done, and our laboratory is known all over for these studies, has been my way of paying homage to my friend, the late Percy-Lancaster.

## PERCY-LANCASTERS: DOYENS IN INDIAN HORTICULTURE \*

T. N. KHOSHOO, *Director, National Botanic Gardens, Lucknow*

Three generations of gardeners bearing this name, have served Indian horticulture over a period of about three-quarter of a century. They worked incessantly and with ability having left a name in the history of horticulture. The first was Mr. Percy Joseph Lancaster, a banker, whose hobby was gardening. He came to Lucknow in 1889. The Superintendent of the Horticultural Garden, was his friend of many years' standing and Mr. Lancaster would pay frequent visits to him to learn more about gardening. He was particularly interested in crossbreeding *Canna* and *Amaryllis*, of which he had to his credit a number of varieties popular in the nineties. In 1892, Mr. Lancaster moved to Calcutta as the Secretary of the Agricultural and Horticultural Society of India. He maintained his interest there in hybridization work, and in 1902 he crossed *Cooperia* and *Zephyranthes*. The resulting hybrids were however lost at the time of his death in 1904.

Mr. Lancaster during his secretaryship introduced many useful plants from Europe, the Far East, and South America. He wrote a number of articles most of which were published in the Journal and Proceedings of the Society. His wife, Mrs. Ida Gordon Lancaster, was an amateur painter and her paintings of plants are housed in the National Botanic Gardens.

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\* Reprinted from *Indian Horticulture*, April-June 1966.

Lancasters first son, Sydney, representing the second generation of gardeners was born on July 19, 1886 at Meerut. His maternal grandfather conducted an aptitude test, when the baby could just sit up. He spread before the boy different articles, each symbolising a profession. Unmindful of their representational value young Sydney picked up the *Khurpi*. This indicated the boy's taste for gardening. He made a *Canna* hybrid when he was just eleven years old. In 1902 he was apprenticed to the Agricultural and Horticultural Society and on his father's death in 1904, he was appointed an Assistant. In 1910 he became an Assistant Secretary and then the Secretary in 1914 till his retirement in October, 1953, after a long service to the society and to the Indian horticulture as a whole.

In November, 1953, he joined the National Botanic Gardens as Senior Technical Assistant because of his early life association with Sikandar Bagh. He wished to spend the remainder of his life at Lucknow where gardening traditions of his family began. He served National Botanic Gardens till January, 1959 when his son, Mr. Alick Percy-Lancaster pressed him to join the family at Salisbury (Southern Rhodesia). But after his wife's death in 1960 and Alick's death in 1961, he returned to the National Botanic Gardens in November 1961.

During the work of about half a century in Calcutta, Mr. Percy-Lancaster has introduced many new plants from abroad. He had particular fascination for hybridization work and many plants found nowadays in Indian gardens owe their origin to him. A complete list of the hybrids is catalogued in the records of the Royal Agri-Horticultural Society. In recognition of the service rendered by the Society, King George V permitted to prefix the word 'Royal' to the Society's name.

To mention a few of his creations, his zoned Cosmos called 'Alipore Beauty' renamed 'Radiance' by the famous American seedsman, Bodgers, has been distributed all over the world. There are many Cosmos variations in cultivation, the choicest being the 'Bicolor White Crest'. He has also developed a beautiful pyramidal headed Hollyhock from a presumed cross between *Althaea rosea* and *Malva sylvestris*. Repeating his father's cross between *Cooperia* and *Zephyranthes*, he obtained a large number of colour variations in the ensuing hybrids named *Cooperanthes*. These hybrids are far superior in colour and performance to either parent. *Cooperanthes* has now been merged in *Zephyranthes* proper. Besides these, he made a number of crosses at varietal and specific level in genera like, *Amaryllis*, *Barleria*, *Bauhinia*, *Begonia*, *Bougainvillea*, *Canna*, *Cassia*, *Chrysanthemum*, *Crinum*, *Hedychium*, *Hemerocallis*, *Hibiscus*, *Ixora*, *Lagerstroemia*, *Petunia*, *Poinsettia*, *Rosa*, *Tecoma* etc.

#### KEEN-EYED MAN

His keen eye never missed any worthwhile spontaneous mutation (somatic and otherwise). Mention may be made of the interesting mutants discovered in *Acalypha*, *Codiaeum*, *Hibiscus*, *Malvaviscus*,

*Panax, Sansevieria* etc.

In National Botanic Gardens, he got an opportunity of utilizing his knowledge in horticulture for public use. He helped to beautify many parts of the garden, in particular the conservatory with which he has an association as a boy. At present he is continuing his work on *Althaea, Amaryllis, Canna, Cosmos, Petunia* etc.

In recognition of his success with *Cooperanthes*, Prof. Hamilton P. Traub (Plant Life Society, USA) named in 1954 a horticultural genus x *Sydneya* after him. This genus is based on the hybrids from the cross *Zephyranthes* x *Habranthus*. In horticulture several 'species' and 'varieties' arising from hybridization or as mutations are named after Lancaster. To quote a few of the important ones, *Acalypha lancasteri*, *Antignon lancasteri*, *Bougainvillea* 'Alick Lancaster', B. 'Enid Lancaster', B. 'Mrs. Lancaster', *Cassia* x *lancasteri*, *Crinum lancasteri*, *Hibiscus* 'Percy-Lancaster', *Panax lancasteri*, *Sansevieria trifasciata lancasteri*, *Zephyranthes lancasteri* etc.

#### A TALENTED AUTHOR

Mr. Percy-Lancaster, is a talented author of the gardening manual, 'An Amateur in an Indian Garden,' published in 1929, and shortly appearing in its enlarged third edition. For over 60 years he has written several hundred articles on various aspects of gardening and garden plants as a Gardening Correspondent to several Indian newspapers, monthly magazines, and foreign journals. He edited the material of the Royal Agri-Horticultural Society from 1904 to 1920, when this publication ceased. Thereafter Annual Reports of the Society carried items of interest and short articles by him. He was also the author from 1935 to 1953 of the monthly 'Garden News Sheet' which was regularly published except for about two years during World War II.

He has written 55 bulletins published by the National Botanic Gardens. This collection ranges from detailed accounts on ornamental plants to plant breeding simplified, sacred plants of Hindus, garden lay out, etc. He gave several broadcasts, lectures, and popular talks to gardening clubs, schools and institutions. A fact may not be known to his friends that he composed a large collection of poems.

As a garden planner, he has helped a large number of amateurs not only in Calcutta but in several other Indian cities. He is in constant demand as judge at flower shows.

He was elected to the Linnean Society of London in 1920. At present he is Secretary of the Garden Lovers Society, Lucknow, and has helped to organize flower shows.

The Amaryllis Society of America awarded him the 'Herbert Medal' in 1939 for "his eminent services in cross-breeding." The Royal Agri-Horticultural Society of India awarded him the 'Carey Memorial Gold Medal' in 1962 for his long service to horticulture.

The third generation of gardeners in this family was represented by Mr. Alick Percy-Lancaster, the younger twin son of Mr. S. Percy-

Lancaster. Born on July 21, 1912, Alick showed a great love for plants during childhood. In 1930 he joined as an apprentice at the Royal-Agri-Horticultural Society getting training for a year from his father. He proceeded to the Royal Botanic Gardens, Edinburgh for training for three years, and thereafter to Kew for further training. On his return to India, he was appointed Superintendent of gardens of the Governor's estate in Bengal. Subsequently, he joined as Assistant Superintendent, Horticultural Division, Central Public Works Department, New Delhi where he was in-charge of parks and public gardens of New Delhi. He rose to be the Superintendent, and later was the first Director of Horticulture, CPWD. In this position his advice on the horticultural side of town planning was sought by various States and he was associated with Chandigarh and Rourkela. Like his father, he too had the privilege of being a judge at flower shows and garden competitions.

Mr. Alick Percy-Lancaster was a prolific writer and contributed to a number of dailies and magazines. For three years he continued to publish 'Garden Chat', a monthly bulletin and remained a regular speaker at the AIR on gardening subjects.

He resigned in 1956 and left India to settle in Salisbury (Southern Rhodesia) where he passed away after a short illness in 1961.

The three generations of these famous gardeners are survived by Mr. Sydney Percy-Lancaster, who entered his eightieth year in July last [1965, deceased May 9, 1972]. He is actively interested in a number of plant species and is writing several bulletins. In fact the only link between him and the world is the heap of unfinished work. The lovers of horticulture can hardly forget him.

## HERBERT MEDAL PRESENTATION

*At The Los Angeles States and County Arboretum Arcadia, CA*

A special event of the Eleventh Annual Show of the Southern California Hemerocallis and Amaryllis Society was the presentation of the Herbert Medal to Mr. John M. Cage. Mr. Cage earned this prestigious award for his outstanding research in the breeding and culture of *Amaryllis*.

Dr. Thomas W. Whitaker, Executive Secretary, The American Plant Life Society, presented the Medal to Mr. Cage on Sunday morning, April 27, 1975, in the Lecture Hall of the Arboretum, before Society members and visitors. Also present were his charming wife, Mrs. Mildred Cage, and previous Herbert Medal Award winners, Quinn Buck (1969), and Leonard Doran (1972). Dr. Ruppel of Argentina, an award winner in 1971, had planned to be present, but was delayed by transportation difficulties.

Dr. Whitaker commended Mr. Cage for his exciting discoveries in the breeding of *Amaryllis*, particularly for his development of techniques leading to the production of inbred breeding lines.

In his acceptance speech, Mr. Cage spoke of the joy and satisfaction

derived from creative work with this group of beautiful plants. He sketched briefly some of his accomplishments in the field of *Amaryllis* breeding, and outlined the interesting goals that lie ahead. Mr. Cage is evidently one of those few talented and remarkable individuals that



Fig. 3. Dr. John M. Cage, left, responding after receiving the 1975 HERBERT MEDAL from Dr. Thomas W. Whitaker, Society's Secretary, far right. Mrs. Cage in center. Photo by Phil Rosoff.

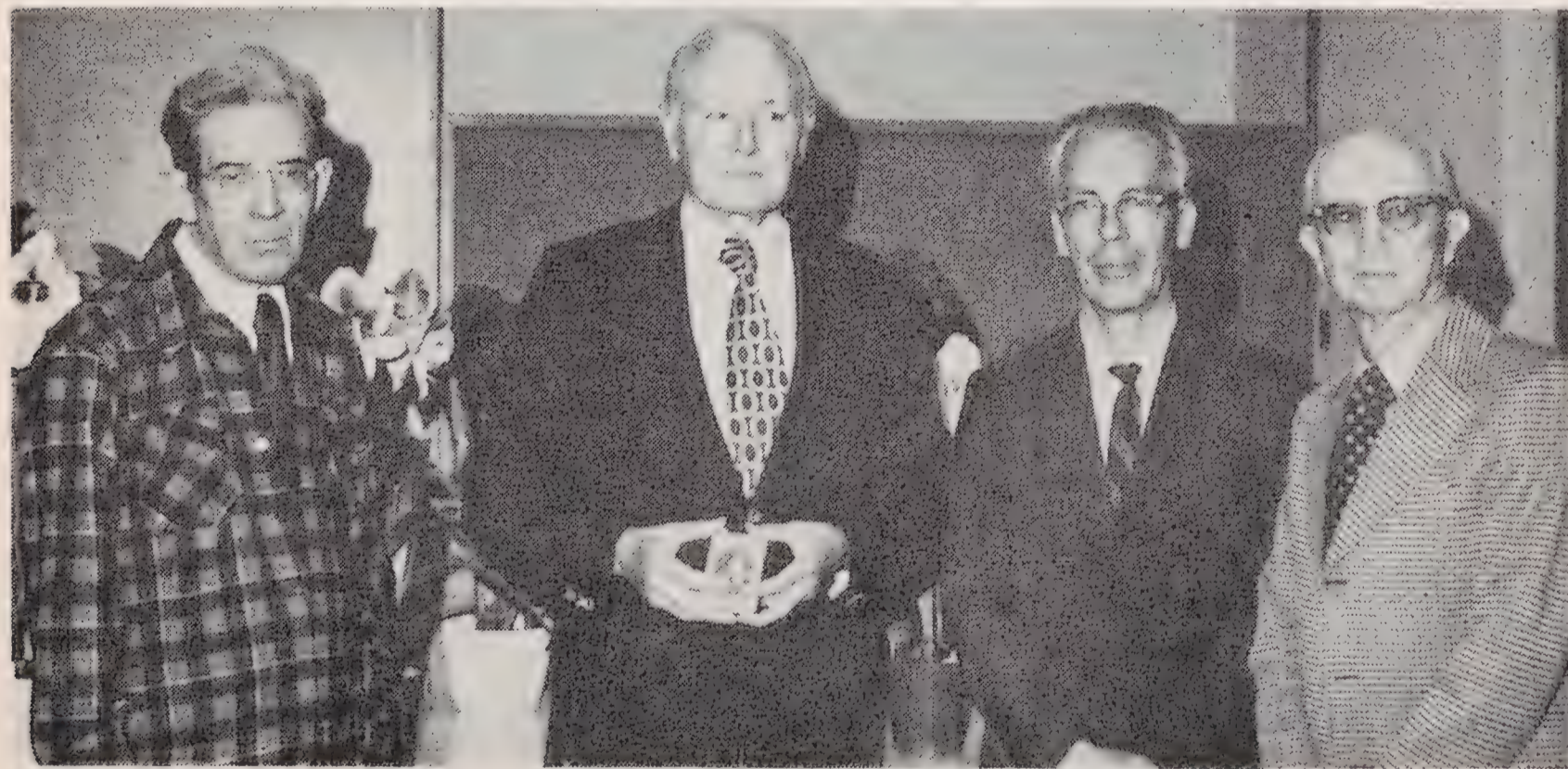


Fig. 4. Three HERBERT MEDALISTS present at the presentation ceremony, from left to right, W. Quinn Buck, 1969, Dr. John M. Cage, 1975 and John L. Doran, 1972. Dr. Thomas W. Whitaker, Society's Secretary, far right. Photo by Phil Rosoff.

have made notable contributions to both their vocation and their hobbies. Mr. Cage is a skilled electronics engineer (now retired), in addition to being one of the very best of our *Amaryllis* breeders.  
—Thomas W. Whitaker

## DONALD D. DUNCAN, NEW CHAIRMAN OF THE ALSTROEMERIA COMMITTEE

We are happy to announce that at last we have a new Chairman of the Alstroemeria Committee, a post left vacant since the death of Harry L. Stinson in 1961.



Fig. 5. Donald D. Duncan in his Washington *Alstroemeria* plantation, 1975.

Mr. Duncan was born in Newberg, Oregon and is in his 44th year. He graduated from Oregon State University in Corvallis, with the degree in Floriculture. He served as an officer in the United States Air Force, and since leaving the Air Force has been active in floriculture, and in the florist trade. He has been interested in floriculture since he was 14 years old, and has been manager of a Florist shop in Seattle for the past ten years. It goes without saying that he is keenly interested in *Alstroemerias* and especially the breeding of these fine plants.

All who have species and hybrids of *Alstroemeria* should get in touch with him so that an inventory can be made of the species now in the United States.—*Hamilton P. Traub*

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### EDITOR'S MAIL BAG

On May 9, 1975, we greatly enjoyed a visit from Dr. Carlos A. Gomez Ruppel, of Argentina, Mr. C. D. Cothran and Mr. Sterling Harshbarger from the Los Angeles area. Dr. Ruppel and his wife have been on an extended visit to the United States, including the Miami, Florida area, the Houston, Texas area, and Brownsville in the Lower Rio Grande Valley of Texas.

Mr. Fred B. Jones, the 1961 WILLIAM HERBERT MEDALIST (see PLANT LIFE, Vol. 17, 1961) has published "Flora of the Texas Coastal Bend". He was honored at a reception at Corpus Christi (Texas) Museum, on February 16, 1975, sponsored by the Corpus Christi Museum and the Welder Wildlife Foundation.

We are saddened to announce that Mrs. Lydia C. Pahls, a native of New York who came to Miami, Dade County, Florida in 1926, died January 21, 1975. She was a member of the American Plant Life Society, Fairchild Tropical Garden, and South Florida Garden Club.

On October 3, 1975, we enjoyed a most interesting visit from Mr. Laurie Bell, a plant nurseryman, 186 Great North Road, Henderson, Auckland, New Zealand. Mr. Bell is on a trip to the United States, Europe and South Africa, and will contribute an article on what he saw to the 1977 PLANT LIFE.

We are saddened to report that William D. Morton, Jr., died on November 11, 1975 at his home in Pensacola, Florida. Mr. Morton received the WILLIAM HERBERT MEDAL in 1963 for re-establishing the registration of *Amaryllis* cultivar names after World War II. An autobiography with portrait of Mr. Morton appears in PLANT LIFE 19: 6-9, 1963. At Christmas time in 1974, Mr. Morton sent greetings from his new home in Florida, stating that he intended to devote his time to *Amaryllis* growing.

Under date of November 22, 1975, Harry Blossfeld, Rua Pedro 360, Tremembe 02371, Sao Paulo, Brasil, writes that he is still working on his 2-volume book on *Gardening in Brasil*, and therefore has less time to correspond with his many friends abroad, and hopes that they will understand his silence.

**PLANT LIFE LIBRARY**—continued from page 10.

of the multiple interactions between environment and organisms. After explaining the aims and developments of plant ecology, the author discusses energy change and productivity; soils—chemical and physical properties in relation to the plant root; plants and water deficit with respect to physiological and ecological aspects; water-logged soils; mineral nutrition, and competition. A bibliography and index complete the volume. Highly recommended to all interested in ecology.

**THE SHIKIMATE PATHWAY**, by Edwin Haslam. John Wiley & Sons, 605 3rd Ave., New York 10016. 1974. Pp. (1-vii) + 316.—Shikimic acid was discovered nearly ninety years ago, but its biochemical significance was not realized until the 1950's when it was noted that it is an important intermediate in one of the major pathways of metabolism of aromatic compounds in nature. The chapters are concerned with the biosynthesis of aromatic amino acids; the chemistry of intermediates; metabolites of the shikimate pathway; metabolism of aromatic acids by micro-organisms and by higher plants; phenylpropanoid compounds and their derivatives, and miscellaneous metabolites, in higher plants. An index completes the volume. Highly recommended to all interested in the pathways of metabolism.

**THE COMPLETE BOOK OF HOUSEPLANTS UNDER LIGHTS**, by Charles Marden Fitch. Hawthorn Books, Inc., 260 Madison Av., New York 10016. 1975. Pp. 275. Illus. \$9.95.—In this volume, the well-known horticulturist, Charles Marden Fitch, who has grown plants under lights for two decades, shares his accumulated knowledge about this method of gardening with gardeners generally. The book is in two sections. In the first he deals with the **basics of light gardening**, the different kinds of lamps and reflectors, and how to install them; where to use lights, the newest fixtures, carts, stands, the latest research findings simplified and condensed for the practical gardener. Section 2 is devoted to the **growing of plants**—the culture of many species suitable for light gardening with recommendations for day- and night-length, proper distance between foliage and lights, and other guides to facilitate culture. Highly recommended to all gardeners.

**NEW YORK TIMES BOOK OF INDOOR AND OUTDOOR GARDENING QUESTIONS**, edited by Joan Lee Faust and Lisa Oldenburg. Quadrangle-New York Times Book Co., 10 E. 53rd St., New York 10022. 1975. Pp. i-ix + 214. Illus. \$7.95.—This book is in three sections. Under **Trade Secrets**, we learn that the book is the outgrowth of the **New York Times** Garden page question and answer column. Thus, the distilled knowledge from this source has provided the material for the book. The second section is devoted to the answers concerning **indoor and city gardening**, particularly plants in pots, on the terrace, ground floor and high rise. The third section is concerned with **outdoor gardening**—nature's helpers and hinderers; compost, mulching; lawn tips; ground cover care; herbaceous plants, vines, shrubs and trees; edibles, cooking, curing, drying, storage and many other hints. Highly recommended to all gardeners.

**LOW MAINTENANCE PERENNIALS**, By Robert S. Hebb. Quadrangle-New York Times Book Co., 10 E. 53rd St., New York 10022. An original paperback. Pp. 220. Illus. \$4.95.—In the first section, the author explains that there are two groups of perennials—those requiring a great deal of pampering for survival, and those which may be less demanding, and which may also be less familiar to the gardener. It is the latter group which is treated in the present volume. The second section is devoted to recommended perennials of low maintenance; retail nursery

**PLANT LIFE LIBRARY**—continued on page 92.

## 1. REGIONAL ACTIVITY AND EXHIBITIONS

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### THE 1975 AMARYLLIS SHOW SEASON

The season began very early on March 8th and 9th with the *Coastal Bend Amaryllis Show* at Corpus Christi, Texas. The *Greater Houston Amaryllis Club Show* was held on April 6th. Two Amaryllis shows were staged on April 12th and 13th: The *Amaryllis Society of Mobile (Alabama) Show* and the *Houston Amaryllis Society Show*. The *Southern California Amaryllis Show* was held on April 26th and 27th. The show season ended with the *Spring Extravaganza* staged by the *Southern California Hemerocallis and Amaryllis Society*.

The *Alabama Amaryllis Society Show* was not held in 1975, but plans for the 1976 show are being made. The report of the *New Orleans Men's Amaryllis Club* show was received late and had to be placed at the end. No report was received from the *Baton Rouge Amaryllis Society*.

#### NOTE TO AMARYLLIS SHOW ORGANIZERS

It is important to designate some one to write a *brief* review of the official show, and to send this promptly to Dr. Hamilton P. Traub, Editor, Amaryllis Year Book, 2678 Prestwick Court, La Jolla, Calif. 92037. *Your plans are not complete until this appointment has been made.* Only in this way is a permanent international record of your show assured.

### COASTAL BEND 1975 AMARYLLIS SHOW

MRS. CARL C. HENNY, *Corresp. Secy.*,  
*Coastal Bend Amaryllis Society, Box 3054,*  
*Corpus Christi, Texas 78404*

Our "Festival of Flowers" presented by the Corpus Christi Council of Garden Clubs was held here in our Coliseum on March 8th and 9th, of this year. We members of the Coastal Bend Amaryllis Society were a bit dubious in regard to having any specimens to enter in our Exhibit due to such an early date for the show. Much to our surprise we did have twenty four entries to be judged. Our weather for this winter has been very changeable with little rain and many cold, dry northers each week-end. However, we did have a week or so of unusual hot weather for this time of the year, which did help to bring out a number of Amaryllis scapes for bloom.

Among the Ludwig named and registered, Amaryllis entered were 'Candy Cane,' 'Gipsy Giant', 'Peppermint', 'Salmon Tower', 'Little Sweetheart', 'Melody Lane', 'Red Man' and 'Twinkling Star' of the Gracilis Type. Mr. E. P. Adams entered a cross between 'Apple Blossom' and 'United Nations', and a cross between 'Ludwig's Dazzler'

and 'Trixie'—in the Breeder's Class. Both scapes scored 90 points.

Mrs. Carl C. Henny received the Silver Bowl Award which took the place of the Ludwig Challenge Cup, for her entry of Ludwig's 'Candy Cane.' She also received a Special Trophy for the greatest number of blue ribbons awarded—for entries in the Breeders Class. Mrs. Henny was given an Award of Merit by the Council of Garden Clubs for her entry of a Ludwig Type Seedling which scored 97 points.

Mr. Duane C. Eckles was given the "Seal of Merit" for his entries of Gracilis 'Melody Lane' with a score of 90 points, and also 'Red Man' and 'Twinkling Star'—with both scoring 95 points, since he was not eligible for the Silver Bowl Award which cannot be won two years in succession.

Mr. Eckles also received the Award of Merit, given by the American Amaryllis Society for his entries of 'Red Man' and 'Twinkling Star', both scoring 95 points.

A Special Trophy was awarded a non-club-member, Mr. J. M. Mabe, for his entry of 'Peppermint' which scored 93 points.

Judges for our show were Mrs. Charles Sanders, Mrs. C. E. Weeks, and Mrs. Reid B. Cochran, all National Flower Show Judges. We were unable to get an accredited National Amaryllis Judge to help judge our show this year.

## GREATER HOUSTON AMARYLLIS CLUB SHOW, 1975

MRS. SALLY FOX, *Corresponding Secretary*  
1527 Castle Court, Houston, Texas 77006

"Amaryllis Announce Spring" presented a burst of color to visitors to the Houston Garden Center on April 6, 1975. The Staging Committee used bright yellow parasols adorned with ribbon tied amaryllis as the focal point, which was most attractive.

Amaryllis are very effective in arrangements and Mrs. G. D. Everett's committee added much beauty to our show. With varied complimentary material the arrangements were lovely.

Entries were judged by Accredited Amaryllis Judges and trophies were awarded to:—

Mrs. P. A. Froebel, a consistent winner who added three silver trophies to her winning list this year. She was presented the Ludwig Challenge Cup for an Outstanding 'White Favorite' along with the Greater Houston Amaryllis Club tray for a Van Meeuwen specimen 'Glorious Victory', and a covered silver dish for a Ludwig miniature 'Peppermint'. She received Awards of Merit from the American Amaryllis Society.

Mrs. G. D. Everett won a silver plate for an American Hybrid at its peak of beauty with six open florets. She was presented an Award of Merit.

Mrs. Robert Rucker, Jr., won a silver shell for her "Dutch Seedling", which was a solid deep orange of excellent form. She received a Preliminary Commendation from the American Amaryllis Society.

Mrs. John H. Ellett showed an outstanding 'Senorita' in the Species Class and was given a Rosette.

Mrs. Sally Fox, who acted as General Show Chairman, won the Warnasch silver tray for "Sweepstakes".

The show, with fewer specimens than previous shows due to an early Spring in February followed by late Winter in March, was outstanding since there were many "Other Amaryllids" displayed. The "Species" section had about a dozen and the visitors were fascinated with these very small perfect shaped *Amaryllis*.



Fig. 6. Greater Houston Amaryllis Club show, 1975, trophy winners, left to right, Mrs. Sally Fox, Mrs. G. D. Everett, Mrs. John H. Ellett, Mrs. P. A. Froebel and Mrs. Robert Rucker, Jr.

Mrs. A. O. Aschenbeck had an interesting "Educational Exhibit" which included beautiful plants of the sought-after Blue Amaryllis *Procera worsleya* Rayneri, the green *Amaryllis calyptrata* and the pale yellow *Amaryllis evansiae*.

Also, the display of "Dutch Seedlings" was an encouraging factor, proving much thought had gone into the program set up by these novice hybridizers.

In the Gulf Coast Area most of our *Amaryllis* are grown in the garden and the weather is a very important factor, so when we are able to have enough show quality specimens to exhibit we are happy to share them with the public—thereby promoting interest in growing *Amaryllis*.

## 1975 AMARYLLIS SOCIETY OF MOBILE SHOW

(MISS) MILDRED LAUGHLIN, *Publicity Chairman*,  
701 Dauphin Isle Pkway, Mobile, Alabama 36606

President E. A. Wiggins announces winners of Trophies at the Twenty-Second Annual Greater Gulf Amaryllis Show, presented at the Bel Air Mall, April 12-13, 1975 by the Amaryllis Society of Mobile. The Trophies were presented on April 13, 4 p.m. by Huey Summers, Show Chairman and Master of Ceremonies. All trophies being retained for one year, unless otherwise stated.

Mrs. Lois Kountz was the winner of seven trophies which were as follows: the Most Blue Ribbons in show, including Horticultural. American National Bank & Trust Co. Trophy Silver Paul Revere Bowl. The Most Blue Ribbons in the Combined Dutch Hybrid, Potted & Cut Amaryllis Divisions. Swetman Amaryllis Garden Trophy Large Silver Tray with handles. The Most Outstanding Horticultural Potted Bulb Specimen of American Hybrid Amaryllis in Show. The John J. Mason Memorial Trophy. The Most Outstanding Horticultural Potted Bulb Specimen of African Hybrid Amaryllis in Show. T. J. Swetman Silver Trophy. The Most Blue Ribbons in the Combined American Hybrid Potted & Cut Amaryllis Divisions. The Inez Scheuermann Silver Trophy. Most Blue Ribbons in the Dutch Named Varieties. Amaryllis Society Trophy to be retained by first year winner. Most Blue Ribbons in the Unnamed Cut Seedlings. Amaryllis Society Trophy to be retained by first year winner.

C. E. Tagert was the winner of four trophies which were as follows: the Most Blue Ribbons in Horticultural Division: Joseph S. Norton Trophy, Silver chased tray with handles. The Most Blue Ribbons in the Dutch Hybrid Potted Amaryllis Division: Robert Hiram Swetman Memorial Trophy Silver Tray with handles. The Most Blue Ribbons in the Dutch Hybrid Cut Amaryllis Division. Wesley J. Marshall, Sr. Memorial Trophy Silver Tray with handles. Most Blue Ribbons in the Single Bloom Named Division. Amaryllis Society Trophy retained by first year winner.

Mrs. Nell Keown was the winner of three trophies which were as follows: Most Outstanding Horticultural Cut Specimen of Dutch Amaryllis in Show. Claude H. Moore Memorial Trophy. Most Blue Ribbons in the Unnamed Potted Seedlings. Amaryllis Society Trophy retained by first year winner. Most Blue Ribbons in the Single Bloom Unnamed Division. Amaryllis Society Trophy retained by first year winner.

John Clark was the winner of two trophies which were as follows: Most Outstanding Horticultural Potted Bulb Specimen of Dutch Amaryllis in Show. John A. Lamey Memorial Trophy. Best Ludwig Named Variety in the Show, cut or potted. The Ludwig Trophy which is a perpetual revolving trophy.

The following exhibitors each won one trophy: *Mrs. Velma Thompson* for the Most Outstanding Horticultural Cut Specimen of American

Hybrid Amaryllis in Show. Amaryllis Society Trophy retained by first year winner. *Mrs. Claudine Pierce* for the Best Potted Miniature. Amaryllis Society Trophy retained by first year winner. *Freddie Frambrough* for the Best Cut Miniature. Amaryllis Society Trophy retained by first year winner. *Mrs. N. K. Bunch* of Selma, Ala. for the Best American Hybrid Seedling (In Horticulture) Shown for first time. The Men's Garden Club of Mobile Certificate of Honor.

After the judging of the show, the judges were guests of the Amaryllis Society of Mobile at a luncheon.

Officers elected for the 1975-76 term of office are: President: John R. Clark; Vice-Pres: W. A. McCollum; Secretary: Mrs. Olga McCollum; Treasurer: Mrs. Lola Templin; Historian: Miss Carmen Romero.

## 1975 HOUSTON AMARYLLIS SOCIETY OFFICIAL SHOW

MRS. A. C. PICKARD, *Official Show Chairman,*  
1909 Alta Vista, Alvin, Texas 77511

Our annual Amaryllis Spring Show was held April 12-13 at the Garden Center, Houston, Texas.

The Houston climate is very favorable to garden *Amaryllis* but there is always an uncertain blooming season for the selected show date. There were many anxious days preceding our show, wondering if we could be lucky to collect a selection of competitive blooms for the official divisions. As the final hours grew near, we surprisingly filled the tables with mostly cut specimens. There were sufficient entries of pot grown plants to receive the high awards and ribbons.

Award of Merit, the highest score for potted specimen in possession more than one year went to Ludwig's 'Marie Goretti'—exhibitor, Mrs. L. E. Morgan who also received the Amaryllis Society Award, silver pitcher.

Second high score for cut specimen, in possession more than one year was 'Ludwig's Dazzler', exhibitor—Mrs. J. L. Williams, receiving the Society's trophy, silver bowl.

Award for the best cut specimen in possession less than one year, was Van Meeuwen's 'Parcifal', exhibitor Mrs. Troy Wright who also received the Society's silver plate and the Dr. Pickard Memorial Cup.

Highest score for potted plant with two scapes, in possession less than one year was Ludwig's 'Fire Fly', exhibitor Mrs. Clem Smith. She also received the Society's silver tray and the Mildred Triplett Memorial award.

In the Hybridizers Division, the following preliminary awards were given. First Preliminary award—Dutch Seedling, exhibited by Mrs. A. L. Hammond. Second Preliminary award—Dutch xx American Seedling, exhibited by Mrs. E. Johnstone.

Additional ribbon awards were given to members who had the best florets in each division. The Sweepstakes Award and Trophy was awarded to Mrs. J. L. Williams.



Fig. 7. Exhibits at 1975 Houston Amaryllis Society Show. **Top:** Amaryllis propagation from seeds—all stages to blooming bulb at extreme right. **Bottom:** feeding the Amaryllis plant—samples of soil, fertilizers and pest control, specimen insects; insecticides.

The focal point of interest always centered around the Educational Table which was a most interesting display showing the various stages of propagation of Amaryllis. There was soil, fertilizers, mulch, cut florets and pots of blooms of the Amaryllids grown in our area, all of which helped to broaden the interest of gardeners. Cultural information was freely given by the ladies in charge of the display and we are indebted to Mrs. Troy Wright and Mrs. Leo Hellman for this section.

In addition to the Horticulture Show, the Amaryllis Society exhibited in the Tri-Color Section of Houston Council of Garden Clubs, Inc. Twelve Artistic arrangements were entered, all using one or more Amaryllis florets in each arrangement.

## SOUTHERN CALIFORNIA HEMEROCALLIS AND AMARYLLIS SOCIETY SHOW FOR 1975

C. D. COTHRAN, *Show Chairman,*  
1733 North Gibbs St., Pomona, Calif. 91767

The eleventh annual show of the Southern California Hemerocallis and Amaryllis Society was held at the Los Angeles State and County Arboretum lecture hall in Arcadia on April 26 and 27. The theme of the show was SPARKLING STARS, and the theme was fully fulfilled as the flowers arrived, and the show began to take its form.

California had a very cold spring and the *Amaryllis* were slow to open. A week before the show it became a matter of great concern as to whether the Society should hold the show, but with three warm days we went from disaster to a marvelous spectacle. We had 12 exhibitors with about 200 entries, and several hundred cut scapes for display.

The crystal and silver trophies were arranged on the head table by Mrs. Gladys Williams, Show Standards Chairman. A beautiful bowl of soft pink and white *Amaryllis* from Mrs. Rosen was placed to add accent to them. The theme of the show was spelled out in sparkling cut out letters and stars on the wall behind by Mrs. Barbara Gardner. There were a number of beautiful arrangements with *Amaryllis* predominating by Mrs. Melton, Mrs. Harshbarger, Mrs. Macdonald, and Mrs. Rosen, all placed to excite the interest of our show visitors.

The following awards were made by judges Quinn Buck, Polly Anderson, Roger Fesmire, and senior judge Gladys Williams: Sweepstakes—C. D. Cothran, who received most blue ribbons was awarded the Cecil Houdyshell memorial trophy. Runner-up—John Cage, who received the Southern California Hemerocallis and Amaryllis Society Award. Ludwig Challenge Cup—C. D. Cothran for 'Apple Blossom' with a score of 95 points.

Registered *Amaryllis* Other Than Ludwig—John Cage with 'Big Tex' with a score of 95 points.

Best Flower in Show-Judges Award—'Big Tex' showed by John Cage.

Popularity Poll Winner—'Eastern Dream' showed by John Cage.

Hybridizer's awards were given to Henry Meyers for the best



Fig. 8. Outstanding double Picotee Type Hybrid *Amaryllis* exhibited by C. D. Cothran (not 'Double Beauty'). Photo by Phil Rosoff.

Leopoldii type seedling, a large and lovely red; to Ed Pincall for the best Reginae type seedling, which was also a large red; C. D. Cothran for the best small Leopoldii type seedling, a blush pink; to John Cage for best small red gracilis, and for the best belladonna type seedling.

Awards of Merit were given to: John Cage for 'Big Tex' and 'Eastern Dream'. C. D. Cothran for 'Apple Blossom' and 'White Giant'.

Preliminary Commendation Awards were given to: C. D. Cothran for Leopoldii type seedling colored blush pink, for a Leopoldii type seedling colored lime yellow, a large red Leopoldii type seedling, and for a picotee double. Henry Meyers for a large dark red, a large mauve red, and a frilly pink and white, all of the large Leopoldii type.

Rosettes were awarded to Mr. Angell, Mr. Ed Pincall, and to Mr. John Cage for their wonderful table displays of flowers. These table displays always prove to be a tremendous attraction to our visitors.



Fig. 9. Southern California Amaryllis Show, 1975. **Bottom:** General view of part of the show; **top:** Trophies awarded, and bowl of pink and white *Amaryllis* exhibited by Mrs. Rosen. Photos by Phil Rosoff.

Special Judges ribbons are given for unusual colors, and different and interesting flowers. This year Leonard Doran received one for *Amaryllis dorianae* in perfect bloom. This is a small pink trumpet species which has not been seen by very many people up to this time. Joe Werling received one for a nice plant of *Amaryllis papillio*. C. D. Cothran received one for a picotee double, another for an odd pink

veined in rose purple, and another for a lime green beauty.

A very fine educational exhibit was put up by Mr. Jim Weinstock, and as usual this was a great attraction. Small packets of about 15 seed were given to everyone who wanted them and several people were kept busy during the entire period of the show explaining how to grow them. Many said that seed given to them at the show last year were growing well. A number of new members were obtained as a result of this close contact with the visitors who numbered several thousand over the two day period.

## SPRING EXTRAVAGANZA OF LOS ANGELES STATE AND COUNTY ARBORETUM

C. D. COTHAN, *Show Chairman,*  
1733 North Gibbs St., Pomona, Calif. 91767

Saturday and Sunday May 17-18, 1975

The Southern California Hemerocallis and Amaryllis Society was again asked to put in an exhibit of amaryllis and hemerocallis for the sponsoring organization, the California Arboretum Foundation, and the Los Angeles State and County Arboretum. C. D. Cothran, Quinn Buck, and Bob Melton agreed to put on the display for the Society. About 40 amaryllis were taken from Cothran's garden and 8 large tubs of hemerocallis from Buck's garden. Because of a late season the amaryllis were just at the height of their bloom, so some species, some primary hybrids, some Dutch seedlings, and some named Dutch were selected. These were arranged by colors and sizes so that the visitors could see what a wide range of each was available. The hemerocallis in tubs were of the newer varieties, and all with blooms. Most of the visitors who come to the Extravaganza come because they like flowers and gardens, so the exhibit really attracted a lot of attention.

The Extravaganza was open to visitors from eight to five both Saturday and Sunday, and Society members acted as hosts and hostesses during this time. Some 25,000 people visited the gardens during the two days and it is estimated that about half of them visited our exhibit.

## 1975 NEW ORLEANS INTRA-CLUB AMARYLLIS SHOW

L. W. MAZZENO, JR.,  
944 Beverly Garden Drive, Metairie, Louisiana

The Men's Amaryllis Club of New Orleans staged its annual Intra-Club all horticulture Amaryllis Show on April 5, 1975 at the City Park Backer Room. Trophies were awarded in three categories. The best 4-floret specimen, a "Trixie" was displayed by Holly H. Bowers, Jr.; best 3-floret specimen, "Glorious Victory" by Oscar J. Robert, Sr.; and best 2-floret specimen, "Flora Queen", also by Holly H. Bowers, Jr.

The Club's regular annual show was held on April 12-13 and is reported separately.

1975 GREATER NEW ORLEANS OFFICIAL  
ALL-HORTICULTURE AMARYLLIS SHOW

L. W. MAZZENO, JR.,  
*944 Beverly Garden Drive, Metairie, Louisiana*

On April 12-13, 1975 the Men's Amaryllis Club of New Orleans held its sixteenth annual all-horticulture Amaryllis Show. This year's Show was staged in the new Lake Forest Plaza Mall, New Orleans, La. The setting was ideal for presentation of a spectacular show. In keeping with the Club's practice competition was again open to the public who responded with 31 entries, winning 15 ribbons. Total entries were approximately 250.

With a beautiful specimen of "Melody Lane" Mr. A. T. Diermayer won the "Best in Show" rosette. This same specimen also merited for Mr. Diermayer the James Mahan Memorial Award for best registered and named hybrid, the Ludwig Challenge Cup and the MACNO Club Trophy for the best Ludwig hybrid, and the Laurence Mazzeno, Jr. Trophy for best miniature hybrid. His "Anzaldoi" won the Amaryllis Incorporated Award for best Amaryllis Species.

Most awards were taken by Mr. Holly H. Bowers, Jr. One of his "Orion" specimens won the W. J. Perrin Award, runner-up to the Mahan Award. Another took the Reuter Seed Co., Inc. Trophy for best cut flower. With "Beautiful Lady" specimens he captured the O. J. Robert, Sr. Trophy for best three-floret specimen and the Nola Luckett Trophy for best two-floret specimen. In addition he was awarded the George Merz, Jr. President's Trophy for most blue ribbons by a Club member, the Vincent Peuler Trophy for best registered single floret (Ludwig Dazzler), the Amaryllis Society of Baton Rouge Award for best unnamed single floret, and a Sweepstakes Rosette.

Mr. Vincent Peuler won the Member's Choice Rosette with a "Picotee Red Lining", and the Southern Seed and Popcorn Company, Inc. Trophy for runner-up in the breeder's section. The best breeder's hybrid merited the Robert Diermayer Memorial Award for Mr. Victor Pannell. Dr. T. A. Calamari, Jr. won the T. A. C. Construction Company Award for best unnamed and unregistered hybrid. Mr. L. W. Mazzeno, Sr. took the Edward P. Authement Trophy for runner-up to the T. A. C. Award. Mr. E. M. Beckham won a Sweepstakes Award.

The Show Chairman, Mr. A. T. Diermayer, worked untiringly to stage an excellent exhibition. In addition he personally handled the publicity for the Show as he has for several years. This included articles in major horticultural magazines and several TV appearances by members. He was assisted by Mr. L. W. Mazzeno, Jr., Co-Chairman, and all Club members. Special thanks go to all who participated in the Show. In particular we thank our Judges, donors of the trophies and other awards, and the members of the Amaryllis Society of Baton Rouge for their assistance.

PROPOSED CHANGE IN POINT SCALE FOR JUDGING  
AMARYLLIS SHOWS

*Submitted by*  
L. W. MAZZENO, JR.,  
*944 Beverly Dr., Metairie, Louisiana 70002*  
*for*  
*The Men's Amaryllis Club of New Orleans, Inc.*

The Men's Amaryllis Club of New Orleans, Inc. in 1975 staged its sixteenth annual official all-horticulture Amaryllis Show. Through the years our shows have been judged by the official point scale. We have felt for some time that some consideration should be given to the "pose of the specimen" (symmetry of florets about the scape). Our judges have also indicated to us their feeling that pose should be an important criterion in their decisions. Therefore, we are proposing that 15 points be added for "pose of the specimen". To provide for these additional points we propose a like reduction in "conformity to flower color standard". The complete point scale we propose is as follows:

POINTS IN HORTICULTURAL SECTIONS

	Single scape (Cut specimen)	Single scape (Potted specimen)	2 or more scapes (Potted specimen)
Perfection of floret shape .....	15.....	15.....	15
Conformity to floret color standard .....	30.....	30.....	20
Pose (symmetry of floret about scape) ....	15.....	15.....	15
Floret size .....	15.....	15.....	15
Length and character of scape (stalk) ....	5.....	5.....	5
Number of scapes per plant .....	—.....	—.....	10
Number of florets per scape .....	6.....	6.....	6
Fragrance .....	2.....	2.....	2
Foliage .....	—.....	2.....	2
Condition of exhibit .....	12.....	10.....	10
	<hr/> 100	<hr/> 100	<hr/> 100

We sincerely hope that this proposal receives a favorable reply.

(**Editorial Note**—Judges should send in to the Editor **very brief summaries** of their thoughts on this subject for publication in the 1977 PLANT LIFE.)

## 2. LINEAGICS

[BIOEVOLUTION, DESCRIPTION, DETERMINING RELATIONSHIPS,  
GROUPING INTO LINEAGES]

### AMARYLLIS SPECIES AND THEIR HYBRIDS

J. L. DORAN, 1117 N. Beachwood Dr.,  
Burbank, California 91506

#### ***Amaryllis pardina* Hook. f.**

The Flower of *Amaryllis pardina* is always 9" or over in diameter with a white back. The face is white dotted red with petals the same width except the lower petepalseg which is about 2/3 width of others. There is a greenish throat. The flower blushes pale pink on aging if weather is hot. Plant is vigorous and multiplies rapidly, and does not require any kind of special culture. It requires a rest period of about two months at which time watering is greatly reduced. Here we moisten the soil only every couple of weeks during this period. The plant remains evergreen during rest period.

I believe that this would be a very good parent for hybridists to use because of its unique color pattern, large sized flower, vigorous plant, and its very flat flower. It has a very short tube.

#### ***Amaryllis fosteri* Traub**

*A. fosteri* is a unique plant which has up to twelve flowers per scape. I have had seedlings from it which had ten flowers. The flower is a soft salmon color with a hint of green on outside midrib near the ovary. The stamens are exserted and the flower, in many ways, reminds one of a Nerine. The surface of the petals are textured or reticulated. The largest bulbs are 8 cm. in diameter which produce the most flowers per scape, but bulbs as small as 3 cm. dia. will bloom. The scape is quite tall, usually about 3 ft. high and often is near 5 cm. diam. at the top of the bulb. The bulbs offset prolifically, soon filling the pot; even small bulbs offset. Some bulbs rest at any time of year, taking three or four months. Drenches of Benlate seem to benefit the plant. Two teaspoons per gallon are used. I prefer to plant it in a potting mix of 3/4 fine sand and 1/4 coarse organic material with powdered lime and super-phosphate added.

*A. fosteri* seems to cross readily and has produced a large number of seedlings. Crossed with *A. blossfeldiae*, it produced salmon pink tubular flowers from 4 1/2 to 5 inches in diameter. Crossed with *A. lapasense*, it produced rosy-orange flowers 5 to 5 1/2 inches in diameter which were very flat. Crossed with *A. dorianae*, it produced rose, salmon, and red flowers of 4 to 6 1/2-inch diameter. One has marvelous pink (HCC 6 21/1 carmine rose) flowers. Crossed with No. 60, *Amaryllis brasiliiana* Traub & Doran, it gave 6-inch diameter reflexed flowers of a nice color.

**Amaryllis brasiliana** Traub & Doran \*

*Bulb* with tunics light brown, very thick and tough, 7.5-10 cm. in diam., 9-12 cm. long, bulb neck 10-15 cm. long. *Leaves* 8-11, deeply channelled, light green, arching, 70-90 cm. long, 4-4.5 cm. wide, narrowing to the bluntly acute apex. *Scape* 80 cm. long. *Spathe* 2-valved, upright, lanceolate, bluntly acute; bracteoles relatively smaller. *Umbel* 2-4-flowered; flowers horizontal, more than 20 cm. long, 16.5 cm. wide at the apex, narrowing to 6 mm. diam. at the ovary, *pure white*, with a strong, very pleasant *fragrance*. *Pedicels* 7.5 cm. long. *Ovary* elongated, 2.4 cm. long, only 0.7 cm. in diam. *Tepaltube* long funnell-shaped, 8.8 cm. long, 6 mm. wide at the base, enlarging gradually to 2 cm. at the apex. *Tepalsegs* oblanceolate, apices bluntly acute. Top setseg, 14.5 cm. long, 4 cm. wide in widest part; 2 lower petsegs 15 cm. long, 3.9 cm. wide in widest part; 2 upper petsegs 14.5 cm. long, 3 cm. wide in widest part; bottom petseg, 15 cm. long, 2.5 cm. wide in widest part. *Stament* attached slightly below the apex on the inside of the tepaltube; *stamen-filaments* arranged in 4 sets of lengths, 8.5-10.5 cm. long. *Anthers* 9 mm. long, 4 mm. in diam., pollen yellow. *Style* overtopping the stamens by 1.5 cm. *Stigma* trifid, lobes 3 mm. long.—*Hamilton P. Traub and J. L. Doran*

The culture of this plant has not shown particular problems. I prefer fine sand with about  $\frac{1}{4}$  of coarse organic material and a little lime and superphosphate added. It seems to be a little sensitive to watering. It should not be watered until the pot has dried down to just moist. Feeding should be light and often. I prefer liquid fertilizer with a balance where the potash is as high or a little higher than the nitrogen.

Hybrids of *Amaryllis brasiliana* with *A. reginae* produced three-flowered scapes of HCC 821/3 currant red flowers. Tubes were 3-5 cm. long. Flowers were  $5\frac{1}{2}$  to  $6\frac{1}{2}$  inches in diameter and perfumed. This flower color is novel to amaryllis. Crosses with a hybrid which is (*A. evansiae* X *A. aglaiae*) X *A. evansiae*, it produced perfumed flowers 5 to  $6\frac{1}{2}$  inches in diameter of chartreuse color, some with pale rose striae on each side of the keel. Some had heavily ruffled petals. Crosses with *A. lapasense*, it produced seedlings with  $6\frac{1}{2}$  diameter

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\* **Amaryllis brasiliana** Traub and Doran, **sp. nov.** (Amaryllidaceae).

Haec species floribus salviformibus stigmatibus trifido ab Amaryllis viridiflora (Rusby) Traub & Uphof et A. immaculata Traub & Moldenke foliis fere bis latioribus valvis spathae erectis 2—3-plo longioribus et ceteris recedit.

This species belongs to the trumpet-flowered group with the **trifid stigma**, and it differs from its nearest relatives, **A. immaculata** Traub & Moldenke and **A. viridiflora** (Rusby) Traub & Uphof, in having leaves nearly twice as wide, and spathe-valves erect and from 2-3 times longer. It differs also in other particulars. **Holomenifer**: No. 1132 (TRA), Feb. 12, 1973. Grown from bulbs collected 20 Km. w. Victor Hugo, Brasil, and flowered at Burbank, California. Named in honor of the great Federal Republic of Brasil.—**Hamilton P. Traub and J. L. Doran**

flowers with wide petals, all white face with red stripes or rows of red dots. Very beautiful. Almost all were perfumed, some had ruffles. Crossed with *A. traubii*, it produced flat 5½ to 6 inch diameter flowers with perfume. They were from pale pink to rose colored. Some were of outstanding good quality.

## AMARYLLIS CALYPTRATA Ker-Gawler

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(This article was received after the cuts for this issue had been made so that the illustrations sent by Mr. Blossfeld could not be used. However, Mr. W. Quinn Buck, of Arcadia, Calif., (see PLANT LIFE 18: 130-132, fig. 19, 1962) has been successful in growing *Amaryllis calyptrata*, and he has published excellent pictures of this very unusual species. The readers should study these pictures in connection with Mr. Blossfeld's article.—*Ed.*)

This Brazilian species is little known and few people grow it, even if they have a good number of natural species in their collection. The reason may be, that it flowers out of the season, when most *Amaryllis* bloom and so enters but few exhibitions; its green flowers are anyhow more an oddity than a show piece. Moreover it requires a care somewhat different from other species, so that there may be a difficulty to grow it successfully. Yet this species has a character of its own, unforgettable and fascinating on behalf of color, shape and even perfume, though the latter may not be approved by all nostrils.

The plant has its native haunts in the forest-clad, dripping moist mountains of the Serra do Mar in southern Brazil, from São Paulo northwards to the Organ Mountains in the Rio de Janeiro State and some mountain ranges of Espirito Santo. Almost anywhere it exists, it will grow as an epiphyte, on the mossy, gnarled trunks of trees, though rarely above ten feet from the ground. The thick, very succulent roots creep a long distance in the fissures of the bark, through a thin layer of dirt and moss, exploring occasional pockets of humus accumulations. It will bloom twice a year, first in January, that is mid-summer according to local conditions, and again in June, that means early winter in Brazil. The plant is in leaf the year round, and has no visible dormancy period.

Though there are several, and correct, descriptions of *Amaryllis calyptrata*, I venture to give mine, based on habitat observations and on a good number of plants, I am growing for several years.

*Bulb* rarely above 8 or 10 cm in diameter, pear-shaped clothed by grey tunics and practically above the soil surface. Roots thick, mostly on the surface, covered by velvety hairs.

*Leaves* from 8 to 10,, gutter-shaped, 50 to 60 cm long and at widest place 5 cm wide, minutely fluted by 18 to 20 parallel veins. The lower face has a prominent, sharp keel along the center. Leaf color is a deep green on both faces, some plants showing a pale crimson hue on under face near the base. The leaf tip ends in a narrow point. Foliage is

persisting through all seasons.

*Peduncle* 60 cm long, hollow, sub-cylindrical, 2.5 cm in diameter near the base, tapering to 1.5 cm at tip, green, somewhat glaucous.

*Spathe* 8 cm long, by 3 cm broad, two-valved, valves boat-shaped, withering, though still green at anthesis. Two bracteoles present, 5 cm long by 0.3 cm broad at base.

*Pedicels* 4 cm long and 1 cm across, when flowers start opening, but considerably longer when pods develop, cylindric, green.

*Ovary* inflated trigonous, 2 cm long by 1.3 cm in diameter, darker green, set at an angle, thus supporting flowers in a horizontal position.

*Pod* on 8 cm long pedicels, greenish yellow when splitting, measuring 6 cm in diameter, trigonous in shape and deeply constricted between the chambers. Apex a deeply sunk triangular scar, showing in the center the stump of what remains of the style. Each pod contains about 200 seeds, with an average weight of 1.2 grams per hundred, when dry after two weeks.

Seed quite large, 30 by 15 millimeters, oval in shape, flat and papery, clear brown, with margins a clearer grey colour.

*Flowers* generally two, in an opposite position, rarely three on a stem. Buds, when emerging from spathe, show a remarkable trigonal shape, with sharp edges. When they start opening, it can be noted that the extremely long stamens insides are folded back like fish-hooks; at anthesis they stretch straight and one can see their struggle to disentangle by spasmodical movements, until they get free and out of the bud.

*Corolla* soldered at base into a conical tube or 2.5 cm length. On the inside, this tube is closed by a green paraperigone that has the shape of a bladder with a triangular slit, through which stamens and style connect with the ovary. The cartilaginous rim of this paraperigone is somewhat undulated and where it is soldered to the tube, on the outside is clearly marked by a ring of tiny depressions.

*Perigone* has a peculiar shape, to which the name "calyptrata" alludes; *calyptra* means a hood. As before stated, the three outer segments are stiffened by a thick and prominent ridge running lengthwise along the center, thus giving the bud its trigonal shape. When the flowers open, this reinforced "backbone" of the outside segments keeps them in an inwardly curved position and prevents the flower to open wide. Consequently, the inner segments are unable to spread open and just pierce their tips through the clefts between the outer segments, rolling them finally to a spiral, in the vain effort to spread wider. The lowermost inner segment, being only 2.2 cm wide, has more room to spread and does so promptly, when the bud opens, curving back too, after a few days.

While this phantastic shape of a flower develops, the observer notes another exciting show. The *stamens*, hooked back while inside the bud, at first straighten and after a day, their enormous anthers, full 2 cm long and pale lilac, split lengthwise and tuck outside in, showing the greenish-yellow pollen, while they shrivel to a mere 0.8 cm length in two days. While this happens, the pale pink stamen filaments stretch

amazingly in length, until they protrude from the flower to a full 15 cm (6") length; but they do not just grow longer; at the same time, they bend and twist, reacting quickly to changes of light direction and incidence of the sun. Finally they end their dance by bending their tips upwards. The *style* remains bent downwards during the first three days, then stretches to full 18 cm in length and finally bends up near the tip, staying in front of the anthers. The trifid *stigma* unfolds reluctantly and only spreads on the last days of life of the flower.

The most unusual colour of this flower is green, though some authors indulge in calling it yellowish-green or whitish-green, its general appearance is frankly green. On close inspection, one discovers, that the green colour is most decidedly present on the veinings, while what little space is left between these dense reticulations, is somewhat paler green and when the flower is past its best, some yellowish or whitish shades appear. A keen observer may even discover a tiny red rim along the edge of all flower segments, but it is so narrow, that one remains sceptic about it, unless one uses a lens. A faint purplish hue is also present on the outside of the flower spathe and, as stated above, *style* and stamen filaments are pink, except at their base, which is green.

This flower cannot be called a great beauty, but it is unusual and spectacular, it has a formal character and colour of its own and another feature is the strong perfume of exotic aroma, most active during the night. It possibly acts as an attraction for some big green bug, which has a similar smell and may be responsible for pollination. But the humming-birds too, are not quite innocent about the amorous life of this flower.

As to cultivation, it must be remembered, that the plant is ever-green, requiring light and water during the whole year. Furthermore it must be considered, that it comes from a rather cool mountain area (abt. 3000 feet altitude), with average temperatures of 65° F, with but little variations during the seasons (59° F to 70° F). It gets an immense rainfall of 160" per year and whenever it does not rain, dense fogs are sure to prevail each evening and morning. The permanent moisture is supported by this plant by its epiphythic habit; growing on trees, rains drain off immediately and there is no danger of the roots to become asphixiated in a logged soil, because they are mostly superficial.

Translating these facts into the practice of cultivation, it is first evidence, that this species, contrary to most others, has no resting period and needs no dormancy. It requires high atmospheric humidity and a shady, cool place in the greenhouse. It should be potted high, that is, with the bulb entirely above the soil surface, and a very porous potting medium is adviseable. This not only requires more frequent watering, but also implies in regular fertilizing. Like most epiphythic plants, the *Amaryllis calyptrata* is rather sensible to high fertilizer concentrations and solutions above 1: 1000 of any fertilizer formula, should be avoided. Very diluted fertilizer applicated frequently between plain water hosings is much better than strong solutions given two or three times per year, which other *Amaryllis* species of short growing cycle

may take easily.

A curious fact may be remembered. The closest relative species is *Amaryllis fosteri* Traub, a species growing in one of the driest desert regions of Brazil, perfectly adapted to resist extreme drought conditions, tropical heat and very little shade.

## THE CHROMOSOMES OF *AMARYLLIS* *CAUPOLICANENSIS* CARDENAS<sup>1</sup>

WALTER S. FLORY AND GERALD SMITH  
*Wake Forest University*

Only about one-third of the known *Amaryllis* species have had their chromosome numbers reported, and in many cases chromosome types and descriptions are not given for these. Traub (1963) includes 55 species in *Amaryllis* L., but a number of new species have been described in the last 12 years. Earlier Traub and Moldenke (1949) had listed 75 species for the genus, but revisions have since removed some of these species from *Amaryllis* into new or different genera. Bailey's (1949) estimated 70 species, and Willis' (1966) 75 (as *Hippeastrum* Herb.) compare well with the number considered by Traub and Moldenke in 1949.

Using the chromosome number lists compiled by Bolkovskikh, Grif, Matvejeva and Zakharyeva (1969), and by Moore (1973) we find that numbers have been reported for 25 species of *Amaryllis* L. All, except for a few very early and probably mistaken counts, have a basic (or X) number of 11. Of these 17 are diploids, with  $2n=22$ . Polyploid  $2n$  numbers of 33 (3 species), 44 (2 species), and of 55, 66 and 77—1 species each, are known.

In 1972 Martin Cardenas described, in PLANT LIFE, several new species of *Amaryllis* from Bolivia, among them *A. caupolicanensis* which is native in the Province which furnished the specific name—Caupolican. Through the generosity of Dr. Thomas Whitaker we received several seed of this species in the late fall of 1971. These seed were planted December 20, 1971, and 8 of them germinated a few days later. Three of the resulting bulbs have been distributed. Of the five which remain the largest is now 4.5 cm in diameter, and a second over 3.5 cm across. These furnish a good supply of rapidly growing root-tips for cytological study.

Several of these tips have been pretreated in .2% colchicine for several hours and then squashed in 1% Gurr's acetic-orcein. The better slides have been made permanent for purposes of repeated study and photography.

### The Chromosomes of *A. caupolicanensis* Card.

Many good metaphase figures have been available from dividing root-tip cells. A somatic chromosome number of 22 is readily observable

<sup>1</sup> Work supported by a grant from the Research and Publications Fund of Wake Forest University.

in many such cells (Fig. 10). The chromosomes in 5 mitotic metaphases have been measured with an ocular micrometer calibrated into mm (and microns) with the aid of a stage micrometer. Both total lengths, as well as lengths of individual arms, have been determined. The average lengths, for these, in microns, are recorded in Table 1, along with an

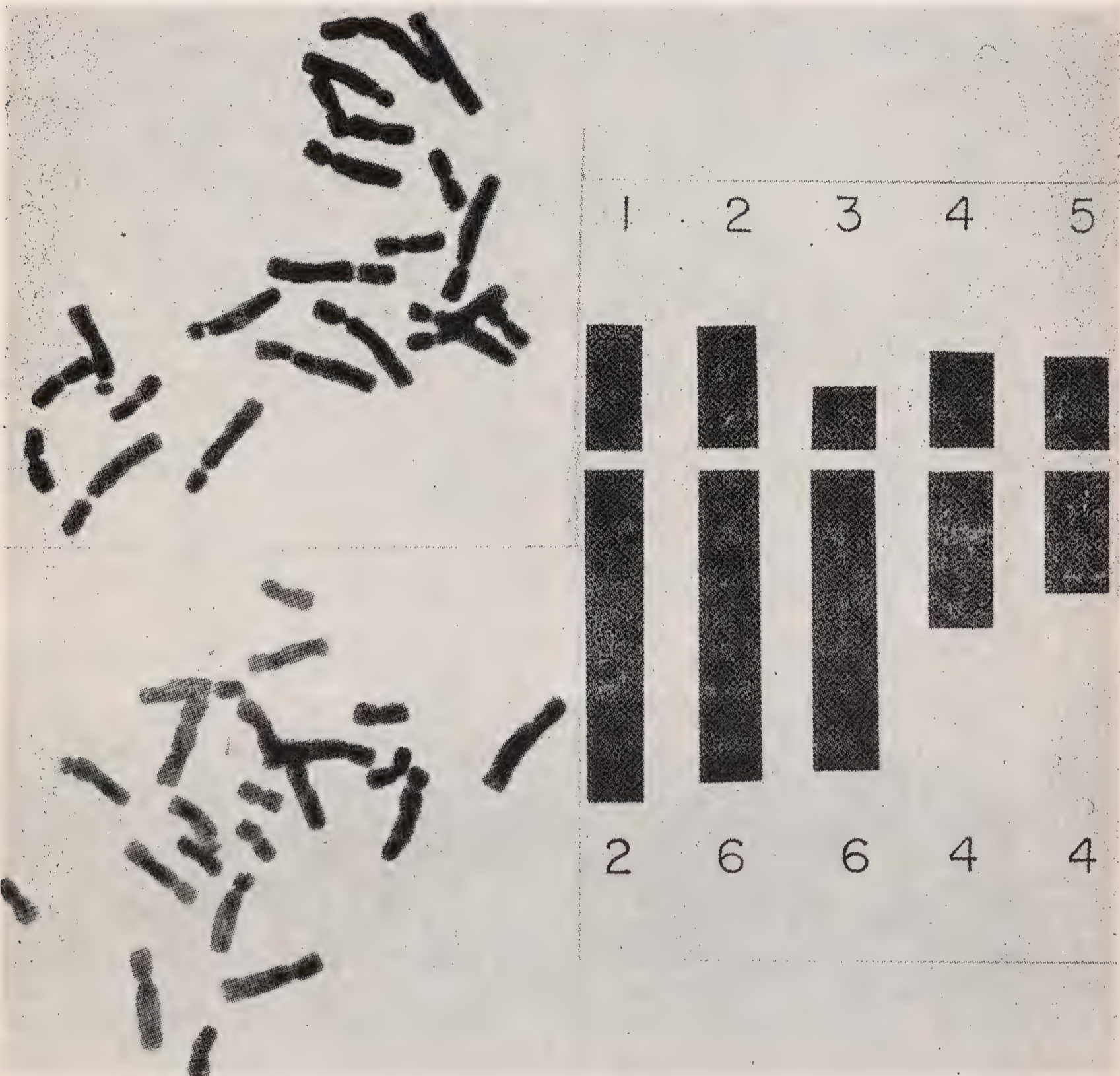


Fig. 10. **Left**, upper and lower plates: Chromosomes of **Amaryllis caupolicanensis**, photographed. X ca. 1320.  $2n=22$ . The chromosomes have been somewhat shortened, and spread, by pretreatment with .2% colchicine for 4 hours. **Right**: Idiogram of the chromosomes of **A. caupolicanensis**, with type number above, and the number of chromosomes of each type below.

index determined by dividing the length of the short arm (S.A.) by the total length of a chromosome (T.L.)—an index indicating the centromere position (see Flory, Cicero and Smith, 1976).

Most of the chromosomes have subterminal centromeres, only the shorter ones being submedian, with the very shortest ones having their

centromeres rather near a median position. From the standpoint of length and centromere position, the chromosomes may be divided into 5 types as noted in Table 1, in the idiogram of Figure 10, and as may be observed in Figure 10. There are 2 chromosomes just slightly longer than 6 others. These two have long arms, and also centromere gaps (not well shown in the idiogram) which are slightly longer than the next six longest chromosomes. (The longer centromere gaps are quite apparent in the 2 longest chromosomes in Fig. 10) There are 6 chromosomes (chromosome 3 in Fig. 10) which have subterminal centromeres, and with their long arms about 5 times the length of the short arm. Then, there are 8 shorter chromosomes, with 4 of these being a little shorter than the other four, and all with centromeres in submedian position. No satellite chromosomes have been observed, probably because of the shortening resulting from the colchicine pretreatments.

Table 1. The types of chromosomes in *Amaryllis caupolicanensis* Cardenas, with total and individual arm lengths (following colchicine pretreatment) expressed in microns, and with S.A./T.L. indices.

Chromosome		Chromosome-Length			S.A.*
Type	Number	Total	Long Arm	Short Arm	T.L.
1	2	10.3	7.3	3.0	.29
2	6	9.6	6.8	2.8	.29
3	6	7.9	6.4	1.5	.19
4	4	4.8	3.0	1.8	.38
5	4	4.2	2.4	1.8	.43

\* S.A./T.L. is the Short Arm length divided by Total Length.

The chromosomes of *A. caupolicanensis* may be compared with those of *A. belladonna* from the Dominican Republic, as well as with those of the species designated *Amaryllis solandriflorum*, from Brazil and Columbia, by Baldwin and Speese (1947). This may be best done by comparing the idiogram (Fig. 10) of this paper, with the idiogram for *A. belladonna* (Fig. 8, Flory, Cicero and Smith, 1976) and the karyotypes for *A. solandriflorum* in Figures 3 and 4 of Baldwin and Speese (1947). All 3 species have 22 somatic chromosomes. In *A. belladonna* each of the 11 pairs of chromosomes have differences from the other 10 pairs, with essentially 11 types being present. Baldwin and Speese found one unequal pair of chromosomes in some, but not all, of their plants. Except for this, the chromosomes of *A. solandriflora* are quite similar to those of *A. caupolicanensis*. Baldwin and Speese divide their chromosomes into 3 types: A (6), B (8) and C (8). If we combined our groups 1 and 2, as well as 4 and 5, *A. caupolicanensis* would have essentially the same types, and numbers of each type, as *A. solandriflora*. Both our Table 1 and Figure 3 suggest that this could be done, although there are slight measurable differences between our types 1 and 2, as well as 4 and 5.

SUMMARY

*Amaryllis caupolicanensis*, a new species from Bolivia described by Cardenas in 1972, has 22 somatic chromosomes. In this paper, these chromosomes are described, figured and divided into 5 types. They are found to be quite similar to the chromosomes of *Amaryllis solandri-*

*flora*, but quite different from those of *A. belladonna*.

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## ZEPHYRANTHES BIFOLIA (AUBLET) ROEMER: ITS CHROMOSOMES AND SOME TAXONOMIC CONSIDERATIONS; AND THE CHROMOSOMES OF AMARYLLIS BELLADONNA L. \*

WALTER S. FLORY,<sup>1</sup> JULIO CICERO<sup>2</sup> AND GERALD SMITH<sup>1</sup>

### I. ZEPHYRANTHES BIFOLIA (AUBLET) ROEMER

The several opinions concerning the taxonomic position of *Zephyranthes bifolia* along with excellent descriptions of this and other species, were carefully expressed by the late H. Harold Hume in *Herbertia*, in 1939.

Carolus Plumier found this taxon on Santo Domingo, which he visited on at least one of his three voyages to America between 1689 and 1697, and began his description of the species as follows: "Lilio narcissus bifolius purpureus." In 1775 Aublet listed Plumier's plant under the binomial *Amaryllis bifolius*. William Herbert (1837) followed by Kunth (1850) and Baker (1888), placed this as a variety of *Zephyranthes rosea*. Roemer in 1847 indicated it as a doubtful species in the genus *Zephyranthes*. C. H. Wright (1914) described *Z. cardinalis* as a new species of *Zephyranthes*, but Hume's careful analysis shows Wright's plant to be the same taxon as the plant first discovered by Plumier.

Hume (1939) summarizes: "When all the characters of this plant are considered, it does not fit clearly into any genus now established. It differs from *Zephyranthes* in having stigmas that are quite broad

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and thickened (not filiform, thread-like or lobed), in filaments that are slightly curved at the tips (not upright), in a definitely declinate flower (not erect or suberect), and a spathe with bilateral tips (not unilaterally bifid). It differs from *Hippeastrum* in its tubular, inflated spathe (not two opposite single valves). Sealy (1937) has placed it in *Habranthus*, but it does not fit there exactly. It differs in its broad stigmas, its inflated spathe bilateral at the tip and in having filaments in two sets of lengths, not in four different lengths. For the present and until additional time and opportunity are afforded for study, it is here left in *Zephyranthes*."

Traub (1951, 1952) recognized the marked difference between *Z. bifolia* and the other *Zephyranthes* species, and placed the former in a separate section *Sibonaya* Traub under the Genus *Zephyranthes*.



Fig. 11. An outline map of the Dominican Republic showing locations and elevations of clones of red-flowered (R), orange-flowered (O), and other (N) *Zephyranthes bifolia* types, and also of clones of *Amaryllis belladonna* (A).

Hume (1939) further added: "It has been suggested that *Z. bifolia* (*Z. cardinalis*) may be an hybrid (Sealy 1937). Since the

nativity of the plant has been established, there does not appear to be satisfactory basis for this assumption.”

George Hamor, in the 1942 *Herbertia*, described the great variation in flower color, scape height, seed setting, etc., encountered among several hundred plants of *Z. bifolia* observed, and later cultured, in the Barahona Province of the Dominican Republic. Padre Cicero also notes this variation, and has found, especially along the International Highway separating Haiti from the Dominican Republic, simultaneous flowering of *Z. bifolia* forms with white, reddish or pinkish and vermillion flowers as well as others with a somewhat obscure dusky rose color. Further, he has noted variation in the form of the petals, with some being wide and others narrow, while some are flat and others are furrowed or keeled. Flowers having stigmas with four lobes have been seen.

In 1959 the chromosomes of *Z. bifolia* were studied and it was reported that  $2n=60$ , with 5 pair of long chromosomes with medium centromeres being present (Flory 1959a, 1959b). Later Flory and Flagg (unpublished) studied additional material of *Z. bifolia* and apparently found some somatic mitoses in which  $2n=72$ , and other showed somatic numbers of  $2n=62$ ,  $2n=64$ , and perhaps other numbers in the sixties.

In 1974 one of the present authors, Padre Julio Cicero, S.J., sent to the workers at Wake Forest University a number of bulbs of *Z. bifolia* and two bulbs of *Amaryllis belladonna* L. The bulbs were collected at diverse locations and elevations in the Dominican Republic on the Island of Haiti—as listed in Table 1, and shown on the map in Figure 11.

It will be noted from Table I that Padre Cicero hybridized the *Z. bifolia* orange (“naranja”) flowered form from Peralta, with pollen from the red (“rosado”) flowered form from Villa Anacaona. Hybrid bulbs were also sent from this combination, which produced flowers of two differens colors, salmon and pink (“roja”), both of which are different from the colors encountered in the flowers of either parent.

Table 1. Bulbs from Dominican Republic received from Padre Julio Cicero, S.J., 1974.

Species	Location	Province	Elevation (Meters)	Date Collected	No.	Flower Color
Zeph. bifolia	Constanza	La Vega	1,160	5/ 5/74	2	red (rosado)
Zeph. bifolia	El Recodo	Peravia	380	5/11/74	2	orange
Zeph. bifolia	Peralta	Azua	400		8	orange
Zeph. bifolia	Villa Anacaona	Dajabon	460	2/11/74	2	red (rosado)
Zeph. bifolia	Valdesia	San Cristobal	100	3/10/73	2	orange
Zeph. bifolia	Orange (Peralta) X	red (rosado)		X4/19/72	2	salmon
hybrid	(Villa Anacaona)					
Zeph. bifolia	Orange (Peralta) X	red (rosado)		X4/19/72	2	pinkish
hybrid	(Villa Anacaona)					(rojo)
Amaryllis	El Recodo	Peravia	380	5/11/74	2	orange-red
belladonna L.						

One of us (Padre Cicero) has observed two very distinct varieties (of *Z. bifolia*), one with flowers of a clear red color that grows in the north in the central mountain ranges more or less associated with *Pinus*

*occidentalis*, with these flowering only during the spring. The second variety has flowers of an orange color and is found toward the south of the central mountain range in moderately humid forests, and this variety flowers all year long. Further, in the south where the orange-flowered *Z. bifolia* occurs are found separated but not entirely isolated populations of *Amaryllis belladonna* L., which also have orange flowers. The possibility suggests itself of natural hybridizations having occurred between *Z. bifolia* and *A. belladonna*, with the orange-flowered forms of the former deriving from genes of the latter. Such a possibility has been tentatively considered and investigated.

## CYTOLOGICAL STUDIES

### Materials and Methods

The bulbs collected by Padre Cicero in 1974 were the materials studied. Cytological preparations were made of all lots listed in Table 1.

The cytological preparations were root-tip squashes, in 1% Gurr's acetic-orcein, following pretreatment for 3 or 4 hours in .2% colchicine. The better temporary preparations were made into permanent slides, permitting more time for both initial study as well as for subsequent rechecking.

### The Chromosomes of *Zephyranthes bifolia* (Aublet) Roemer

One of us (G. Smith) has made numerous cytological preparations from rapidly growing root-tips of each of the accessions listed in Table 1, and the best of these have been the subject of extensive studies by both Flory and Smith, at magnifications of X900 and X1800.

All accessions have the same somatic chromosome number,  $2n=60$ . At times, especially following heavy pressure in squashing, the arms of several of the larger chromosomes are sometimes forced apart. Sometimes the resulting centromere area is so extended that it is easy to at first consider that there are two chromosomes, when actually one is observing the two arms of one and the same chromosome. This, quite apparently, accounted for the chromosome counts above  $2n=60$ , which had been made earlier (see above).

Both arms of each chromosome, of 4 mitotic metaphases in which the chromosomes were well scattered, were measured with an ocular micrometer calibrated into mm (and microns) with the aid of a stage micrometer. These chromosomes vary slightly in length, from cell to cell, due to varying contractions resulting from the colchicine pretreatments. The different chromosome types, however, are quite proportional, and readily recognized, in the different figures. Data for the chromosomes of the four divisions were averaged, and these averages are presented in Table 2.

In addition, an index figure indicating the position of the centromere in the chromosome was calculated. This is presented in the right hand column of Table 2. The index was secured by dividing the length of the short arm by the total length of a given chromosome (S.A./T.L.).

If this index figure is .5 the centromere is median in position, with the arms being of equal length. The less the index, the nearer is the centromere to one end of the chromosome, and the greater is the proportional difference in arm lengths.

Table 2. The classes of chromosomes in *Zephyranthes bifolia* (Aublet) Roemer, with average total, and individual arm, lengths (following colchicine pretreatment) expressed in microns, and with S.A./T.L. indices.

Class by length		Number	Chromosomes length			S.A.* T.L.
			Total	Longest Arm	Shortest Arm	
longest	1A	4	14	7.5	6.5	.46
	1B	4	11	6	5	.45
intermediate	2A	8	8	5.5	2.5	.31
	2B	18	6	3.5	2.5	.41
shortest	3A	6	4	2.5	1.5	.38
	3B	20	3	1.5	1.5	.5

\* Division of S.A. (short arm) length by T.L. (total length)

From Table 2 it will be noted that there are, in general, three types of chromosomes. There are eight longer chromosomes, 26 chromosomes which are of more or less intermediate length, and 26 quite short chromosomes. Further, each of these 3 general groups may be divided into 2 subgroups. Of the longer chromosomes, all 8 have submedian centromeres, with one arm just slightly longer than the other; 4 of these however, are somewhat longer than the other 4. The chromosomes of intermediate length have a group of eight slightly longer ones, which are essentially subterminal with respect to centromere position—one arm being less than half as long as the other. Then there are the 18 slightly shorter intermediate-lengthed ones, which have centromeres in submedian position. Of the shorter chromosomes, there are 6 slightly longer than the other 20. These 6 longer ones have their arm lengths in the ratio of 4 to 6, and their centromeres may best be designated as submedian in position. The shortest ones have almost exactly median centromeres, with the two arms of each being of equal lengths.

Figure 12 shows the 60 well scattered metaphase chromosomes of one mitotic division, the wall of whose cell was ruptured under the pressure of squashing. Figure 12 also shows the same squashed cell photographed at a higher magnification, and further enlarged to give more details of the chromosomes. Figure 12 further shows the 60 chromosomes within an intact cell, with unbroken wall; each of the chromosomes in this plate could be easily distinguished and counted by use of the fine adjustment on the microscope. A number of similar cells, of both types, were observed and studied.

Figure 13 presents an idiogram of the types of chromosomes occurring in *Z. bifolia*. The number, or type, is placed above each chromosome. The number present in the usual complement, of each different chromosome type, is shown by the number below each diagrammatic unit.

A Comparison of *Z. bifolia* Chromosomes with Those of Other *Zephyranthes* Species

The chromosome number of  $2n=60$  for *Z. bifolia* is unique for this genus, so far as known. Other somatic numbers for *Zephyranthes* species

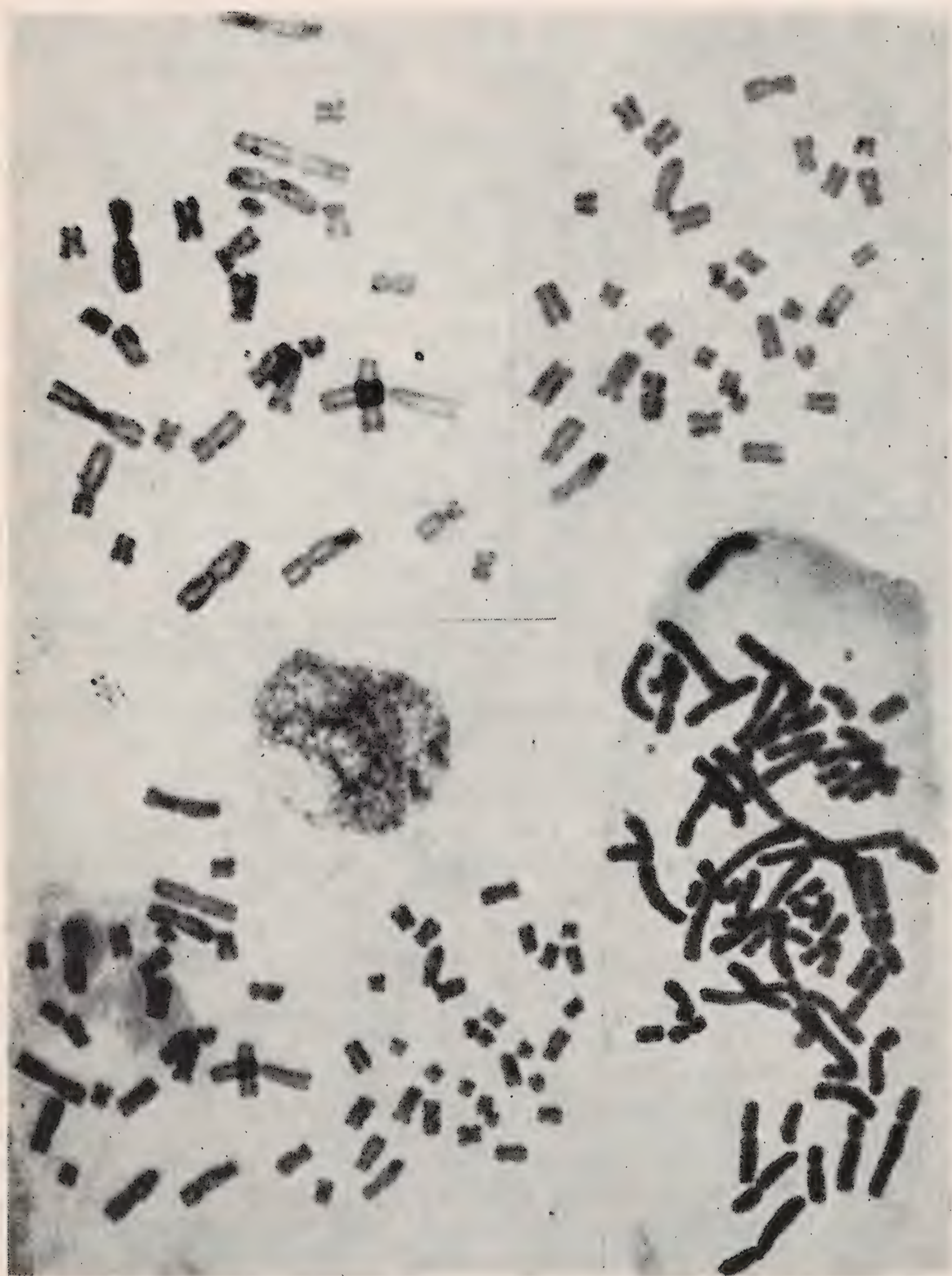


Fig. 12. **Top:** Mitotic metaphase from root-tip cell of *Zephyranthes bifolia*.  $2n=60$ , cell wall was broken in squashing. **Lower left:** The same mitotic metaphase as shown on top, but at lower magnification. **Lower right,** Mitotic metaphase from root-tip cell of *Z. bifolia*, showing  $2n=60$  chromosomes in a dividing cell with an unbroken wall.

range from 18, through 24, 25, 28, 36, 43, 48 and about 96 to one with about 108 (Flory, 1968). The numbers 48, and then 24, are most frequently encountered. In general, the types and proportional lengths of chromosomes in *Z. bifolia*, however, are quite similar to those in other species of this genus as well as of *Habranthus*. For example, for similarly prepared material of *Z. insularum* ( $2n=28$ ) the chromosomes range in length from 3.5 to 14.5 microns, with the S.A./T.L. indices running from .46 down to .25; while in *Z. nervosa* ( $2n=24$ ), the lengths are from 4 to 12 microns, and the indices from .47 to .31 (Flory, 1959). The chromosome statistics—except for number—for these two (and other) species, therefore, are quite comparable with respect to size and centromere position with those of *Z. bifolia*. Good preparations of somatic mitosis in *Z. bifolia* do give the impression of having a greater proportion of quite short chromosomes per cell, than is usual for *Zephyranthes*, and the data in Table 2 lend support to the observation.

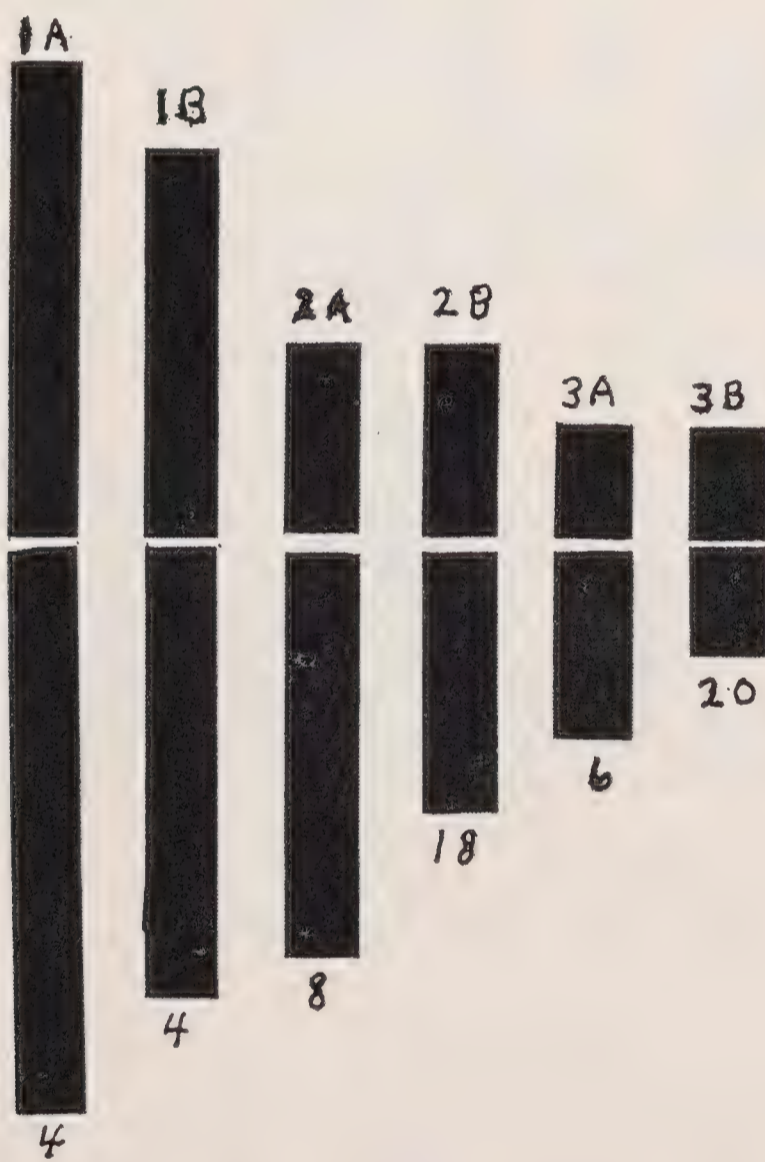


Fig. 13. Idiogram of the types of chromosomes (numbered at the top) found in somatic cells of *Zephyranthes bifolia*, with the number (below) of each types of chromosome in the complement.

## II. THE CHROMOSOMES OF *AMARYLLIS BELLADONNA* L.

And a Comparison of These with Those of *Zephyranthes bifolia*

A number of workers have reported on the chromosomes of *Amaryllis belladonna* (including Inariyama, 1937; Sato, 1938 and 1942; Ficker, 1951; and others).

However, as stated earlier, this species is represented at several places in the southern parts of the Dominican Republic, and sometimes grows in close proximity with orange-flowered clones of *Z. bifolia*. Since the orange, or orange-red flowers of *A. belladonna* are quite similar in color to those of the orange-flowered *Z. bifolia*, it seemed desirable to compare the chromosome types of these two species. As observed, by previous workers, *A. belladonna* has 22 somatic chromosomes (Fig. 14). Each member of one subterminal pair (chromosome 5) bears a small satellite. The satellite is dimly apparent on one pair of chromosomes in Figure 14, but in the complement in which the chromosomes have been shortened more by the colchicine pretreatment, the trabants are not visible.

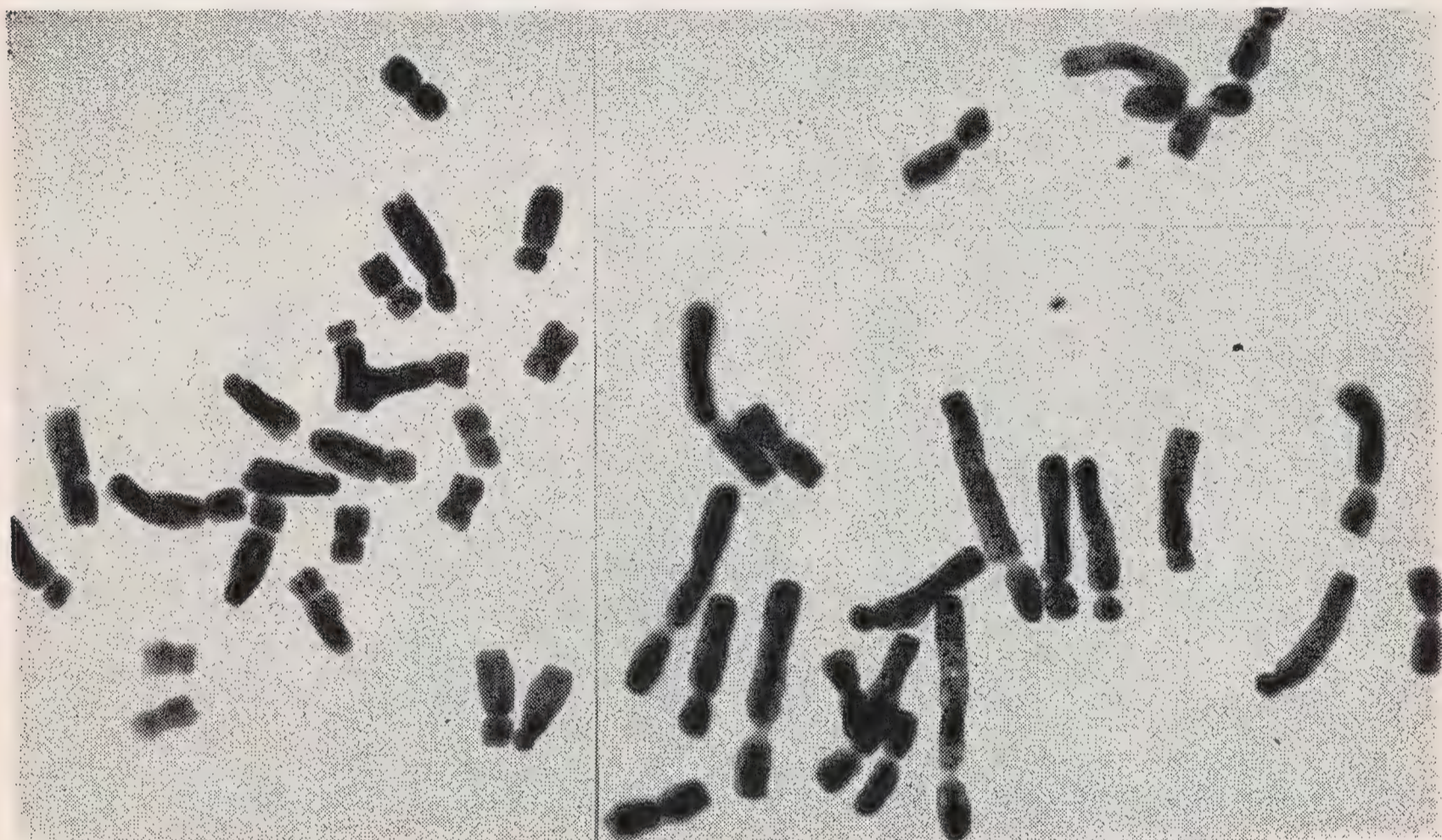


Fig. 14. Mitotic metaphases from root-tips cells of *Amaryllis belladonna* L.  $2n=22$ . The chromosomes of the plate, **on the left**, were more affected and shortened by the colchicine pretreatment, than were those on the plate **to the right**.

Figure 15 depicts an idiogram of the 11 types of chromosomes found in *A. belladonna*.

A comparison of the chromosome complements of *Z. bifolia* and *A. belladonna* does not show many similarities. In the complements measured the average chromosome length in the former is 6, and in the latter 11.5 microns—although varying effects of the colchicine pretreatments on chromosome coiling and shortening could be partly responsible for the differences. *Z. bifolia* has 28—almost half—of its chromosomes with either median or near median centromeres (Table 2), and all chromosomes of its complement taken together have an average S.A./T.L. index of .43. In *A. belladonna* there is only one pair of chromosomes with median centromeres, and only two other pairs that approach this

condition (Table 3); the average index for all chromosomes here is .32.

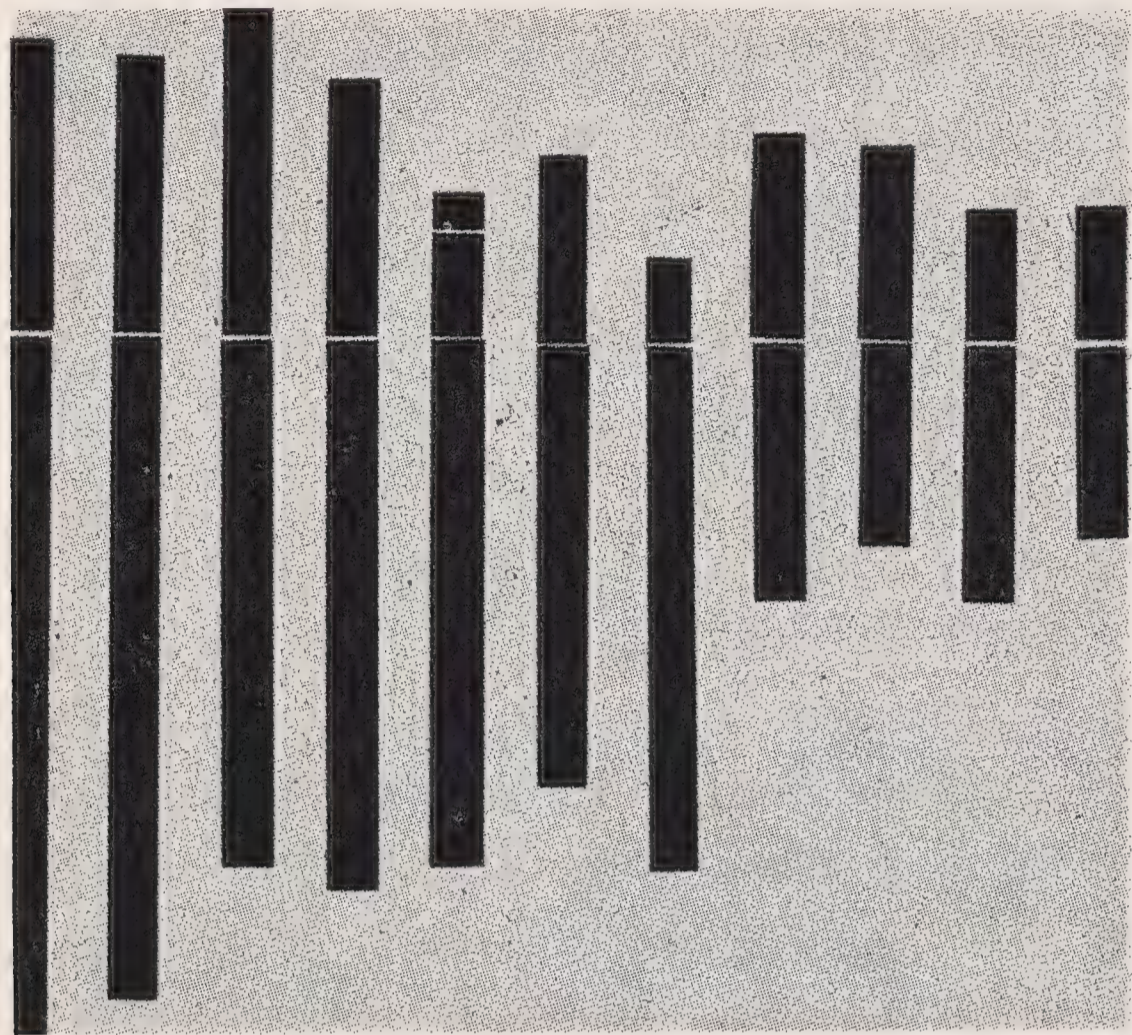


Fig. 15. Idiogram of the types of chromosomes in *Amaryllis belladonna* L. ( $2n=22$ ).

So far as can be cytologically detected, then, there do not appear to be any chromosomes of the *A. belladonna* size and types, in the *Z. bifolia* complement. If hybridization has occurred between these two taxa there is no easily apparent cytological evidence for it. In addition, more than a dozen cross-pollinations of *A. belladonna* with good amounts of *Z. bifolia* (orange) pollen have been made in 1975, and an approximately equal number of reciprocal pollinations. No sets, or initiation of sets, have resulted from any of these attempted crosses. These results indicate the difficulty of successfully crossing these two taxa, under controlled conditions at least.

Table 3. The classes of chromosomes in *Amaryllis belladonna* L., with total, as well as individual arm, lengths, expressed in microns, and with S.A./T.L. indices.

Chromosome Number	Chromosome Length			S.A.*
	Total	Long Arm	Short Arm	T.L.
1	18.6	13.4	5.2	.28
2	16.7	11.8	4.9	.29
3	15.2	9.4	5.8	.38
4	14.3	9.7	4.6	.32
5	11.8	9.4	1.8+.6	.20
6	11.2	7.9	3.3	.29
7	10.9	9.4	1.5	.14
8	8.2	4.6	3.6	.44
9	7.2	3.6	3.6	.50
10	7.0	4.6	2.4	.34
11	5.8	3.4	2.4	.41

\* S.A./T.L. equals Short Arm length divided by Total Length.

## DISCUSSION

*Zephyranthes bifolia* is quite distinct from any other known representative of the genus, in certain of its flower colors; in its wide range of flower colors under natural conditions; in the stigma, filament, flower inclination, spathe and other character differences pointed out by Hume, Hamor, and others, and in its chromosome number.

This species offers attractive opportunities for attempted hybridizations with other *Zephyranthes* species, with *Habranthus* species, and perhaps with other amaryllidaceous plants. Such further studies offer the possibility of throwing additional light on the relationship, origin and phylogeny of this colorful and interesting taxa. Further, there exists a good possibility of securing some interesting, and perhaps spectacular, hybrids by the use of *Z. bifolia* in a breeding program.

## SUMMARY

This work describes in detail the somatic chromosomes of the Dominican *Zephyranthes bifolia*. The study has been made on both the red and the orange flowered types, as well as on variants of these. In this species  $2n=60$ , a unique number for this genus. In addition, the chromosomes of *Amaryllis belladonna* from the Dominican Republic have been studied and compared with those of *Z. bifolia*. There are practically no chromosome similarities between the two taxa, and limited efforts to cross them have failed.

*Zephyranthes bifolia* has a number of similarities with, but also a number of differences from, other *Zephyranthes*. There remains much to determine concerning its origin and relationships. The variety, beauty, and size of its flowers make it a promising parent for hybridization studies aimed at producing useful new horticultural types.

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## AMARYLLID NOTES, 1976

HAMILTON P. TRAUB

*Clivia* x *cyrtanthiflora* (Van Houtte) Traub, *comb. nov.* Syn.—*Imatophyllum cyrtanthiflorum* Van Houtte, *Flore des Serres*, Ser. II. viii (1869) 87, pl. 1877; err. *Imantophyllum* in Benth. & Hook, f., Gen. iii. 729. 1883.

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*Allium traubii* Howard, *Plant Life* 23; 61-62; 91. 1967; 23: 138. 1968.

A detailed examination of the flower in 1975 has revealed that the ovary is definitely shortly 6-crested. However, as the ovary swells after anthesis, the very short crests gradually disappear.

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**MIERSIA CHILENSIS**, Poso & Zoellner, continued from page 120.

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## REGISTRATION OF NEW AMARYLLID CLONES

MR. JAMES M. WEINSTOCK, *Registrar*  
 10331 Independence, Chatsworth, Calif. 91311

This department has been included since 1934 to provide a place for the registration of names of cultivated *Amaryllis* and other amaryllids on an international basis. The procedure is in harmony with the International Code of Botanical Nomenclature (edition publ. 1961) and the International Code of Nomenclature for Cultivated Plants (edition publ. 1958). Catalogs of registered names, as well as unregistered validly published names, will be published from time to time as the need arises. The first one, "**Descriptive Catalog of Hemerocallis Clones, 1893-1948**" by Norton, Stuntz and Ballard was published in 1949. Additional catalogs of cultivars have been published since 1949: **Catalog of Brunsvigia Cultivars, 1837-1959**, by Hamilton P. Traub and L. S. Hannibal, PLANT LIFE 16: 36-62. 1960; Addendum. PLANT LIFE 17: 63-64. 1961; **Catalog of Hybrid Nerine Clones, 1882-1958**, by Emma D. Menninger, PLANT LIFE 16: 63-74. 1960; Addendum, PLANT LIFE 17: 61-62. 1961; **The Genus X Crinadonna**, by Hamilton P. Traub, PLANT LIFE 17: 65-74. 1961; **Catalog of Hybrid Amaryllis Cultivars, 1799-1963**, by Hamilton P. Traub, W. R. Ballard, La Forest Morton and E. Authement, PLANT LIFE. Appendix i-ii + 1-42. 1964. Other catalogs of cultivated amaryllids are scheduled for publication in future issues. These may be obtained at \$7.00 prepaid from: Dr. Thomas W. Whitaker, Executive Secy., The American Plant Life Society, Box 150, La Jolla, Calif. 92038.

The registration activity of the American Plant Life Society was recognized when at the XVIth International Horticultural Congress, Brussels, 1962, the Council of the International Society for Horticultural Science designated the American Plant Life Society as the Official International Registration Authority for the cultivars of *Nerine*; and this was extended to include all the *Amaryllidaceae* cultivars, excepting *Narcissus* and *Hemerocallis*, at the XVIIth International Horticultural Congress, 1966.

Only registered named clones of *Amaryllis* and other amaryllids are eligible for awards and honors of the American Amaryllis Society at Official Amaryllis Shows.

Correspondence regarding registration of all amaryllids such as *Amaryllis*, *Lycoris*, *Brunsvigia*, *Clivia*, *Crinum*, *Hymenocallis*, and so on, should be sent to Mr. Weinstock at the above address. The registration fee is \$2.00 for each clone to be registered. Make checks payable to American Plant Life Society.

## REGISTRATION OF NEW AMARYLLIS CLONES, 1975

**Registered by Dr. John M. Cage, 1041 Ruth Av., Yuba City, Calif. 95991**

**Amaryllis** clone 'Cage's Coral' (Cage, 1975); **A-1007**; U-4 to 5 fld; 26-h; perigone 2¾" long, 8½" across a flat but slightly recurved face, Chinese Coral (HCC 614/1). Vigorous and long-lasting winter bloomer with a narrow picotee around all segs, and bearing two scapes.

**Amaryllis** clone 'Marlys' (Cage, 1975); **A-1008**; U-4 to 5 fld; 25" h; perigone 3" long, 8½" across a slightly recurved face which is white overlaid with a dramatic flush and picotee of claret rose (HCC 021). Winter-spring bloomer with slightly wavy edges, deep rose ring in the throat, and bearing two scapes.

**Amaryllis** clone 'Myra' (Cage, 1975); **A-1009**; U-4 fld; 12" h; perigone 1¾" long, 3¼" across face, solid dark red (R. H. S. 46B) both front and back of segs. Winter bloomer with very regular flower form, florets tilted slightly upward, and pointed segs which are ¾ imbricated.

### 3. GENETICS AND BREEDING

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#### BREEDING THE "HADECO" AMARYLLIS HYBRIDS

F. BARNHOORN, JR., *P. O. Box 7, Maraisburg, Transvaal  
Republic of South Africa*

When the firm, Harry Deleeuw Company, started its *Amaryllis* breeding project in 1948, there was no summary of *Amaryllis* breeding available such as Traub's 1958 book, nor any studies on *Amaryllis* inbreeding (Cage, 1975). We had however the end results achieved by the many English and Dutch *Amaryllis* hybridists over a century, from Ker & Co., in England to Ludwig & Co. in the Netherlands (see Traub, 1958). We hereby wish to express our gratitude for this wonderful heritage. We have attempted to use this vast reservoir of germ plasm to increase the number of outstanding *Amaryllis* clones available to the world.

Thus, the exact origins of our stocks of *Amaryllis* are not known due to the breeding methods used by our predecessors (see Traub, 1958). Mr. Barnhoorn started by crossing hybrid named clones from various firms in the Netherlands with a clone obtained in South Africa, named 'Dr. Pont'. Many crosses between these gave rise to our modern clones propagated vegetatively.

To qualify for acceptance a new hybrid clone has to conform to or surpass some very stringent criteria.

Points taken into account are the following:

- (1) Number of blooms per stem.
- (2) Number of stems per bulb (size of bulb taken into account).
- (3) Length of stems.
- (4) Time taken from potting till flowering (time of potting taken into account viz-early or late in season).
- (5) Clarity/Pureness of colour as sought.
- (6) Shape and general appearance of blooms.
- (7) Size of individual blooms.
- (8) Public acceptance of colour.
- (9) Sturdiness of stems.
- (10) Aspect of blooms in relation to stem and to other blooms on the same stem.
- (11) Ease of and dependability in forcing (important for commercial potplant growers).
- (12) Size of bulb needed to produce 2 good stems.
- (13) Time-lag between appearance of first and second flower stem.
- (14) Lasting time of blooms.
- (15) Whether plant produces foliage together with—or after flowers.
- (16) Ability of bulbs to reproduce fast by vegetative means naturally (i.e. number and size of off-shoots formed per year).
- (17) Growth-rate of bulb per year.



Fig. 16. "Hadeco" Hybrid Amaryllis. **Top:** workers in Amaryllis field at "Hadeco" farm near Johannesburg. **Lower left:** "Hadeco" clone 'Bold Leader' packaged as a Christmas gift. **Lower right,** little girl watering pots of clone 'Africana', and the clone in flower after six weeks.

- (18) Resistance to disease.
- (19) Shape and general appearance of the bulb.
- (20) Condition of root-system.
- (21) Ability of bulb and roots to stand up to long periods of storage under controlled temperatures.



Fig. 17. "Hadeco" Hybrid **Amaryllis**. **Top:** machine capable of washing 50,000 **Amaryllis** bulbs per day. **Lower,** dipping trays in which bulbs are left in fungicide solution for 15 minutes after washing.

At the present time some 15,000 hybrids are tried out every year. In the past however when Mr. Barnhoorn was going all out to

get a good white and good pure pink variety some 2 acres (comprising  $\pm 90,000$  bulbs) was planted out with crosses. For the whites alone, some 400 numbered hybrids were in our books, from which the best 2 were selected to remain for cultivation and sale.

The method of obtaining a new variety through hybridizing is as follows:—

Say that one has an *Amaryllis* which produces large red blooms. This plant however has the following faults or drawbacks:



Fig. 18. "Hadeco" Hybrid *Amaryllis*: **Left**, the farm at Brits where about 50% of the bulbs are grown, viewed from the air. **Right**, temperature and humidity controlled chamber for storage of *Amaryllis* bulbs.

(a) The shade of red is too "light" and "flat". (b) The stems are too short. (c) The plant often produces only 2 to 3 blooms per stem and only 1 stem per bulb.

The method to follow then is to cross this variety with a dark red variety which is very free flowering and has tall stems. The blooms of this variety may be small.

The resulting hybrids will have characteristics of both parent plants plus others from previous generations. The resulting hybrids have not

only inherited the best points of the parents however. About 99.9% of the hybrids will be discarded because they will be inferior to the mother plant.

The parentage of the resulting new varieties is kept secret because it has been found that same varieties produce a high percentage of good offsprings while most do not. These "good" parents are therefore repeatedly used in the hybridizing program, the variety used being dependant on the improvements wanted.

A complete record is kept of every cross together with all its characteristics as outlined above.

When a batch of new hybrids flowers for the first time, the first step is to number the plants which show outstanding points. Such a numbered hybrid is then increased and tried out for 5 more years. If, in the meantime a better hybrid has come to light, the first one is discarded. If on the other hand the numbered variety comes up to all expectations it is increased as rapidly as possible through off-shoots. Such a variety is then given a name and offered for sale by sending sample consignments and photographs to selected trade customers throughout the world. A variety is ready for commercial sale about 9 years after its seed was first sown out. After that time about a 1.000 full size bulbs will be available.

The largest selling single varieties at present are "Bambara" and "Zanzibar" which are both signal red. Of each of these varieties some 120.000 bulbs are sold yearly at present. These 2 varieties were both hybridized in 1952. They flowered for the first time in 1955. These 2 varieties are forcing varieties and are extremely dependable. The bulbs of these varieties are practically all sold to potplantgrowers because of their dependability and ease of forcing.

The Company does not distribute its Amaryllis bulbs retail. Only the trade is supplied.

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### A CODE SYSTEM FOR PLANT BREEDERS

JOHN M. CAGE, 1041 Ruth Ave.,  
Yuba City, California 95991

When one breeds amaryllis or other genera over a period of several plant generations, identification and the keeping of records become laborious and confusing. When two or more generations of plant breeders are involved in a project, a good code (or identification) system is of utmost importance. The lack of a good system has resulted in much time-consuming labor, many errors, and probably the loss of whole breeding programs upon the death of breeders.

The simplest way to label a seedling is to assign a separate number

to it and record the number and parentage in a notebook, but after a while one must carry the notebook with him and search endlessly in it to identify a particular seedling.

The classical method of describing a cross is to label it  $A \text{ ♂} \times B \text{ ♀}$  when the pollen of plant A is used on the stigma of plant B. The little symbols that tell which is the male parent, and which the female, are a bit of a nuisance to me and to printers, and I notice that many breeders just assume that  $A \times B$  means that A is the male or pollen parent. I do not quarrel with the scientific notation in its usual application, but it falls short as a way to record clearly the maximum information in the minimum space. Neither do I suggest that the coding system described here is the only solution to the problem. It has served me well for many years, however, and it may be useful to others.

Assume that a breeding program starts with several plants, each of which is designated by either a number, a letter, or a convenient abbreviation. For instance, let us start with the named amaryllis clone "Fire Dance," the Species *A. aurica*, and a special selection from a group of inbred siblings numbered 127. First we assign a letter to each sibling of interest—127A, 127B, etc. The following designations are easy to remember:

F (for "Fire Dance")

AUL (for *A. aurica*)

127A, 127B, 127C, etc.

A cross between two plants is shown by a fraction, with the numerator always the pollen parent. Thus the pollen of "Fire Dance" on *A. aurica*, would be either

$$\begin{array}{ccc} & & \text{F} \\ & & \text{---} \\ \text{F/AUL} & \text{or} & \text{---} \\ & & \text{AUL} \end{array}$$

and we choose seedling C of this cross for further work, giving us

$$\begin{array}{c} \text{F} \\ \text{---} \\ \text{AUL} \end{array} \text{C.}$$

However, if we use the first form of fraction, we seem to have an ambiguity in F/AULC, for AULC could be the C selection of a group of *A. auricas*, and we indicate that C belongs to the fraction as a whole by the dot in F/AUL.C.

Now 127B is crossed on F/AUL.C, giving 127B//F/AUL.C, where the double fraction bar takes precedence and clearly indicates that 127B was crossed upon the previous cross of F/AUL.C. The D selection of the final cross is 127//F/AUL.C.D. Since two dots appear before D in the whole symbol, then D refers back to two preceding fraction bars. To summarize or to practice, look at

$$22/23///24/25.A//26B.C.D$$

which indicates several generations of breeding. Plant 22 was crossed on 23, 24 on 25, and the A selection of 24/25 was used. Then 24/25.A was crossed on 26B, and the selection 24/25.A//26B.C was made. Next,

22/23 was crossed on 24/25·A//26B·C and the final selection D was made.

The fact that there are three dots before D and four fraction bars may seem inconsistent at first, but plant 23 cannot be considered separate from 22 in the complete formula. It might even be argued that the dot before D is unnecessary, since D is a selection of the whole previous breeding program, but I prefer it as is. Notice that the breeder found no reason to indicate a particular selection of 22/23. The system is very flexible.

Since I have been concerned with inbreeding to produce uniform amaryllis strains and vigorous F:1 hybrids, I have selfed many bulbs and crossed many siblings. For brevity, the selfed offspring of plant N is labeled N' rather than N/N. As an example, the 92 red inbred strain has been selfed for four generations, giving such seedlings as 92' ' ' 'C, rather than 92/92·A//92/92·A·B///92/92·A//92/92·A·B·C/////92/92·A//92/92·A·B///92/92·A//92·A·B·C. The last expression is more exact, and it is still much shorter than a verbal description of the history of the strain, but since only a very few of any selfed generation are retained for further breeding, 92' ' ' 'X usually is sufficient.

Similarly, sibling crosses are often designated as 92<sup>v</sup> rather than 92A/92B.

The code requires a little thought at first, but I have found the benefits to be enormous. After a little practice, the system becomes automatic in practice.

A few examples might be interesting. The named clone "Big Tex" has the following formula: F' ' 'B/ATH' 'A·A, where F="Fire Dance" and ATH="Athos." F was inbred for three generations and ATH for two generations before the cross was made to produce the 12-inch beauty, "Big Tex," which is now being propagated by cuttage.

For another example, the 10-inch orange clone "Great Pumpkin" is TORO/AUL'·A//TORO'·B·A'·A///TRI'·A, where TORO="El Toro," AUL=*A. aulica*, and TRI="Golden Triumphator." Both the TORO-AUL strain and the TRI strain are being inbred much further to try to obtain uniform "Great Pumpkin" types from seeds. Results are very promising.

## BREEDING FOR FRAGRANCE IN HYBRID AMARYLLIS

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*Purpose:* Fragrance, a feature of some species of Amaryllis is not usually found in commercially available hybrids. This report is about the attempt to add this trait to existing lines of hybrid Amaryllis.

*Material:* Dutch hybrid bulbs (both named and seeding) were obtained from Ludwig, Van Meeuwen & Hadco sources. None of these bulbs were fragrant—they were of both regular and Gracilis types. These were augmented with Senorita and Gracilis bulbs furnished by the kindness of C. D. Cothran of California.

These bulbs were flowered from March through June of 1975. Some were kept in my residence, others in the greenhouse. No record was kept of the exact location or culture of the individual bulbs.

Pollen was supplied by the cooperation of J. L. Doran of California. It was collected in gelatine capsules and sent to Oregon by mail—being en route up to four days. Three different lots were received.

Upon receipt, the capsules were stored in a household type refrigerator—the jar was removed only while the contents were being used. The capsules were nested in cotton batting placed over  $\frac{1}{4}$  cup of granules of Drierite (Drierite: Anhydrous  $\text{Ca SO}_4$ ; W. H. Hammond Co., Xenia, Ohio). All were contained in a screwtop glass jar—one pint capacity.

*Method:* The first day a flower opened, the stamens were removed. The second day, pollen was applied with a small brush. This was repeated every other day while the flower remained crisp.

Pollen used was obtained from two white trumpet clones. P2—Doran's #60, collected in 1968 in Brazil. Similar to *A. elegans* but tube length, shorter, heavily perfumed. P3—*A. fragrantissima*, a very sweet trumpet from Bolivia.

Table of results is given below. Some pods (labeled aborted) grew for about three weeks, then turned yellow and died. Tiny white seeds could be detected inside.

TABLE 1. Breeding for fragrance in hybrid *Amaryllis*

Pollen	Clone Source	Type	Flowers Pollinated	Aborted Pods	Mature Pods	Notes
P2	Ludwig	Marie Goretti, white	2	0	0	
P2	Ludwig	pink seedling	2	0	0	
P2	Ludwig	orange seedling	2	1	1	(1)
P2	Ludwig	Gracilis - Rubina	2	0	0	
P2	Ludwig	Gracilis - Firefly	2	2	0	
P3	Ludwig	Gracilis - Picture	2	1	1	(2)
P3	Ludwig	Gypsy Giant	1	0	1	(3)
P3	Ludwig	Gracilis - Carina	2	1	1	(4)
P3	Ludwig	Goliath, red	2	0	0	
P3	Ludwig	Marie Goretti, white	2	0	1	
P3	Ludwig	white seedling A	4	4	0	
P3	Ludwig	white seedling B	3	3	0	
P3	Ludwig	pink seedling	2	0	0	
P3	Ludwig	striped seedling	2	0	0	
P3	Cothran	Senorita	1	0	1	(5)
P3	Cothran	Gracilis, red	2	0	0	
P3	Hadco	white seedling	2	0	0	
P3	Van Meeuwen	Gracilis, white A	2	0	0	
P3	Van Meeuwen	Gracilis, white B	2	0	0	

(1) 5 tiny seeds - no germination. (2) 1 small seed - no germination. (3) 26 seeds, 20 germinated. (4) 30 seeds, 21 germinated. (5) 4 small seeds - no germination.

*Remarks:* Seed production and germination, while low, is possible with some crosses. Approximately 30 seedlings are now being grown. It is hoped that more crosses can be made in the 1976 season. If clones of known fragrance could be obtained, it would greatly facilitate the project.

ORIGINS OF THREE TEXAS SPECIES OF  
**ZEPHYRANTHES**<sup>1</sup>

R. O. FLAGG AND W. S. FLORY

*Carolina Biological Supply Co. and Wake Forest University*

The purpose of this paper is to submit and to examine evidence indicating that three quite fertile "species" arose as natural hybrids between *Cooperia* (*Zephyranthes* Subgenus *Cooperia* (Herb.) Traub) and *Zephyranthes* (Amaryllidaceae). These putative parental taxa, often regarded as generically distinct, are here both considered as subgenera of *Zephyranthes*. The three derivatives are *Zephyranthes* (*Cooperia*) *smallii* (Alex.) Traub, *Z. (Cooperia) jonesii* (Cory) Traub, and *Z. (Zephyranthes) refugiensis* Jones. Each was described in comparatively recent years: in 1939, 1950 and 1961, respectively. All three quite apparently resulted from hybridization involving *Z. (Zephyranthes) puchella* J. G. Smith and *Z. (Cooperia) herbertiana* D. Dietr.

## MATERIALS AND METHODS

Distributional and ecological data are chiefly composites of information obtained on collecting trips in October, 1954, and October, 1960, supplemented by examination of specimens in various herbaria: (abbreviations according to Holmgren and Keuken, 1974) ARIZ, C, F, GH, KANU, MISSA, MO, NO, NY, RUNYON, SMU, TEX, TRA, UARK, UC, US, and WWF.

The Royal Horticultural Society Colour Chart was used in color determinations.

Gross morphological data from the Texas coastal bend complex were secured primarily as accessions were collected from native habitats. Some taxa, however, were removed from their natural habitats with data being taken as the plants grew at The Blandy Experimental Farm at Boyce, Virginia. The data cannot be regarded as strictly random as efforts were often made to obtain as many variants as possible. Leaf widths were recorded from the broadest, usually basal, part of the largest leaves. Perianth segments were removed from the flowers to facilitate consistent measuring of lengths of filaments and perianth tubes. The free filaments of *Zephyranthes* species are usually in two alternate sets with respect to length; lengths of the free portions of sepaline filaments were recorded in this study.

Methods of cytological study of root-tip divisions were the same as those employed in previous studies (Flory and Flagg, 1958; Flagg, 1961a). Voucher specimens are deposited in the National Herbarium. In species of *Zephyranthes* meiosis occurs while the bud and scape are

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<sup>1</sup> Investigation supported by N.S.F. Grants G-2716 and G11080 to W. S. Flory. Much of this work was done at The Blandy Experimental Farm of the University of Virginia.

within the bulb and less than 1.5 cm long. As the supply of bulbs of known somatic chromosome numbers was insufficient for wholesale sacrificing, the technique described by Varma (1960) was tried. Although the limited number of bulbs curtailed meiotic studies, certain patterns of floral bud locations became apparent (Fig. 19-3) and were recorded from a minimum of ten bulbs each of *Z. pulchella*, *Z. refugiensis*, *Z. smallii*, *Z. herbertiana*, and *Z. traubii*. Three bulbs of *Z. jonesii* were dissected.

Percentages of aborted pollen were determined from random counts of 500 or more grains from each accession examined, except where stated in the case of *Z. traubii*.

Buds to be pollinated were emasculated one or two days before normal opening and then covered. In a number of control tests run at different times, the ovules did not develop without pollination.

## RESULTS AND OBSERVATIONS

### 1. Distributional and Ecological Relationships

The range of *Z. herbertiana* extends from southern Kansas to Oaxaca, Mexico, and from New Mexico and western Texas to eastern Texas and Louisiana. *Z. pulchella* is apparently restricted to the Texas coastal plain. Although *Z. herbertiana* is found in a variety of habitats, it seems generally better suited to drier conditions than those of the low fields and roadside ditches profusely occupied by *Z. pulchella*.

*Zephyranthes smallii* is only known to occur in and near Brownsville, Texas, primarily in low fields which may be flooded after heavy rains. *Zephyranthes jonesii* is ecologically similar to *Z. smallii* but is found (Fig. 19-1) about 125 miles to the north, distributed over about 2000 square miles in an area extending northward from Corpus Christi to within about 10 miles of Victoria. *Zephyranthes refugiensis*, also found in swales, is contained within the area occupied by *Z. jonesii* and ranges over perhaps 200 square miles (Fig. 19-1). Often *Z. jonesii* and occasionally *Z. refugiensis* thrive in slightly elevated areas that are outside the ecological niche of *Z. pulchella*.

The known distribution of *Z. traubii* is narrow. The few existing herbarium sheets of this taxon indicate that it ranges along the Texas Gulf Coast from Galveston Bay south into Victoria and Calhoun Counties. Our collections extend its southern range into the northern part of Refugio County. Where collected, it has been restricted to low but well drained grasslands.

The several taxa studied here have their chief flowering periods, in native habitats, following heavy autumn rains. At such times *Z. pulchella*, *Z. smallii* and *Z. herbertiana* bloom side by side in the Brownsville area. Various groupings of *Z. pulchella*, *Z. refugiensis*, *Z. jonesii* and *Z. herbertiana* occur and flower together in the Texas coastal bend area (Fig. 19-1). At least one pasture in Refugio County (21.3 miles north of Refugio, on the eastern side of US 77) was found to be shared by *Z. refugiensis*, *Z. jonesii* and *Z. traubii*.

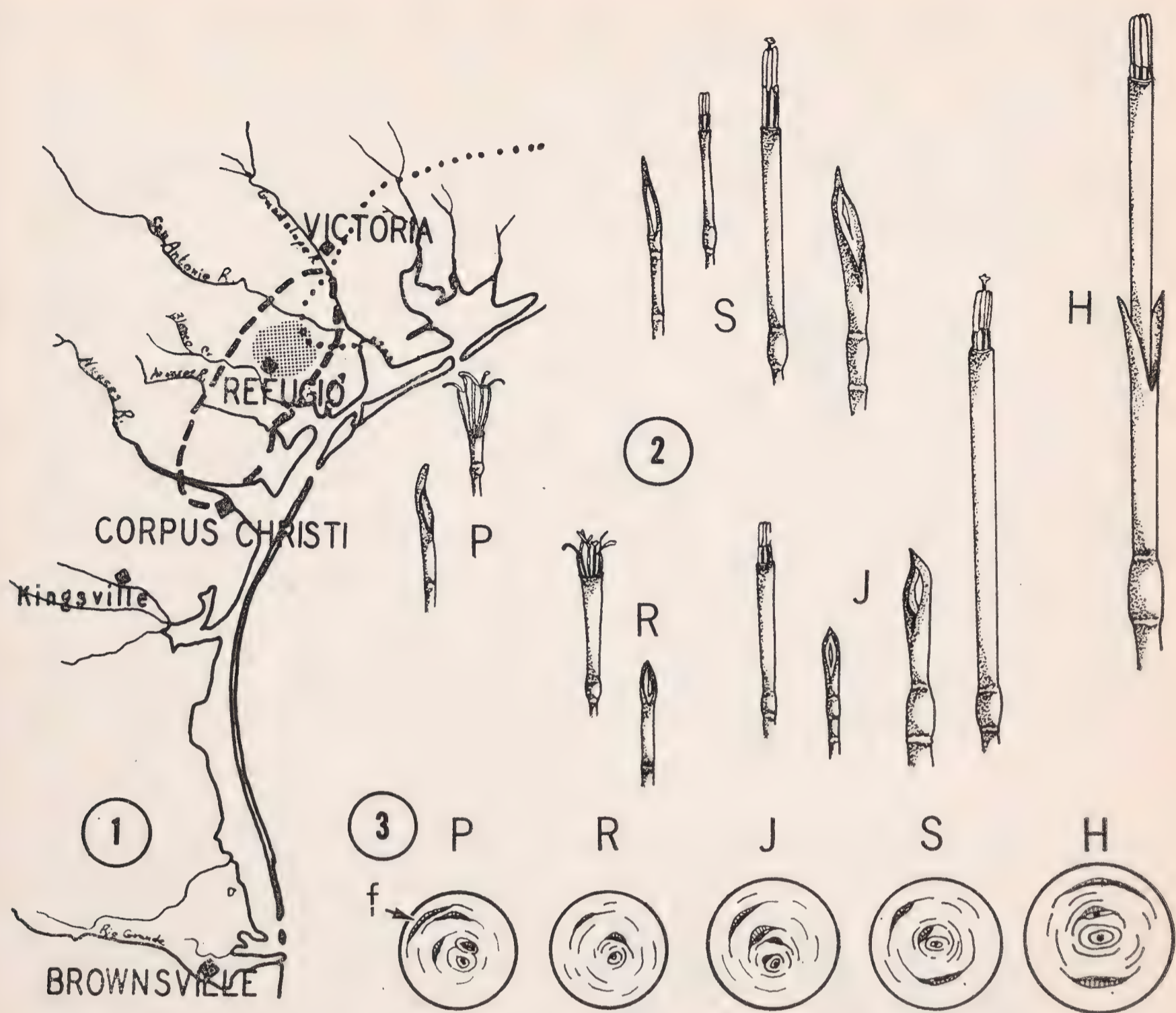


Fig. 19. (1) Map of the lower gulf coastal area of Texas showing distributions of *Zephyranthes refugiensis* (stippled), *Z. jonesii* (within broken line), and *Z. smallii* (Brownsville). The southern range of *Z. traubii* is indicated by the dotted line. *Z. pulchella* and *Z. herbertiana* are sympatric throughout the whole area shown. (2) Sketches of flowers with perianth segments removed; the spathes of all but *Zephyranthes herbertiana* are shown separately from the flowers. (S)—*Z. smallii*; (P)—*Z. pulchella*; (R)—*Z. refugiensis*; (J)—*Z. jonesii*; (H)—*Z. herbertiana*. (3) Diagrams of bulbs in horizontal cross sections showing patterns of bud arrangement. f—floral scale (size somewhat exaggerated for clarity).

Two other members of the tribe Zephyrantheae occur on the Texas coastal plains: *Z. (Cooperia) drummondii* and *Habranthus andersonii* var. *texanus*. Neither of these share habitats with the taxa under consideration. The morphology of the *Habranthus* species is strikingly different from any of the involved taxa. *Zephyranthes drummondii* flowers in the spring.

2. Morphological and Physiological Characters

Data on several pertinent morphological and physiological characters (as many as seems practical) are presented in Table 1, and in Figures 19-2 & 3; 20-4 & 5, and 21-6.

The variation in size and form of perianth of both *Z. smallii* and *Z. jonesii* is much greater than is that of either *Z. pulchella* or *Z. herbertiana*.

Shortly pedicellate forms of *Z. herbertiana*, like that diagrammed in Fig. 20-4 are also known to occur in Oklahoma where there is no other native species of *Zephyranthes*, in several widely separated counties of Texas, and in the state of San Luis Potosi, Mexico.

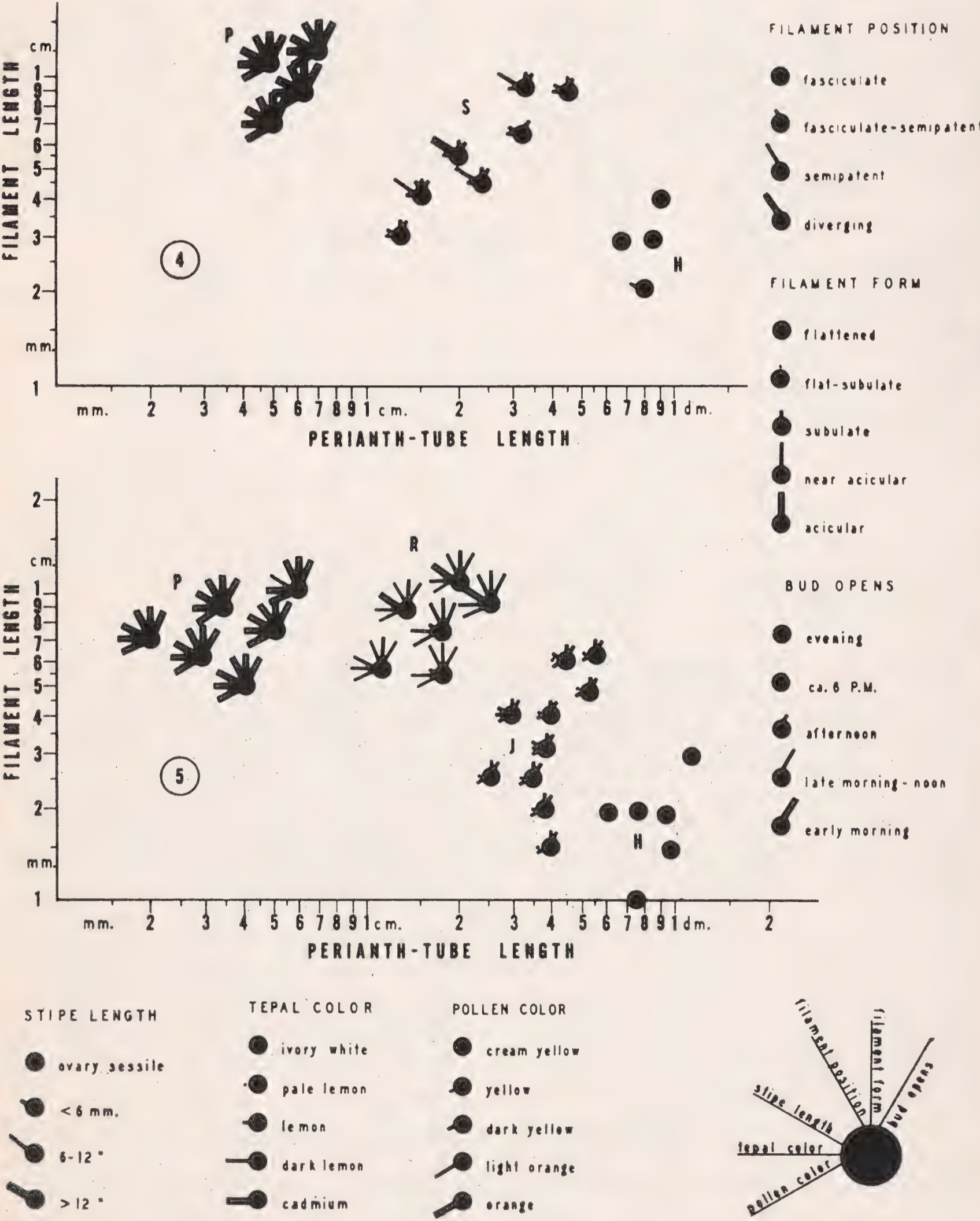


Fig. 20. For caption see following page.

Fig. 20. Pictorialized scatter diagrams (4) and (5) using 8 characters and log-scales to depict *Zephyranthes pulchella* (P), *Z. smallii* (S), *Z. refugiensis* (R), *Z. jonesii* (J) and *Z. herbertiana* (H). Fig. 20-4. Representatives of populations from Brownsville, Texas. Fig. 20-5. Representatives of populations from the Texas coastal bend area. The **direction** of the lines radiating from the glyphs designates the character concerned. Beginning with the line to the lowest left of a glyph (at about "8 o'clock") the character of pollen color is represented. Then clockwise the next 2 lines above represent tepal color and stipe length respectively. Still going clockwise, the upward pointing lines in order (left to right) represent filament position, filament form and time of anthesis. Variations in the characters are denoted by length and width of the lines radiating from the several glyphs—each of which represents an individual plant. Symbolized character descriptions follow. **Filament Position:** fasciculate, solid circle; fasciculate-semipatent, short line; semipatent, long narrow line; diverging, long broad line. **Filament Form:** flattened, solid circle; flat-subulate, dot; subulate short line; near acicular, long narrow line; acicular, long broad line. **Time of Anthesis:** evening, solid circle; ca. 6 PM, dot; afternoon, short line; late morning to noon, long narrow line; early morning, long broad line. **Pollen Color:** cream yellow, solid circle; yellow, dot; dark yellow, short line; light orange, long narrow line; orange, long broad line. **Tepal Color:** ivory white, solid circle; pale lemon, dot; lemon, short line; dark lemon, long narrow line; cadmium, long broad line. **Stipe Length:** ovary sessile, solid circle; less than 6 mm, short line; 6 to 12 mm, long narrow line; more than 12 mm, long broad line.

### 3. Chromosomes

*Numbers*—The chromosome numbers determined for various accessions from the Texas coastal plains are presented in Table 2. As we are dealing with two spatially separate complexes, the taxa from the coastal bend are separated, in Table 2, from those of the Brownsville area.

In the Brownsville area *Z. pulchella* has  $2n=48$ , the predominant form of *Z. smallii* has  $2n=54$ , and the predominant form of *Z. herbertiana* has  $2n=60$ .

Within the distribution of *Z. jonesii*, *Z. pulchella* has  $2n=48$ , and the predominant forms of *Z. refugiensis*, *Z. jonesii*, and *Z. herbertiana* have  $2n=48$ .

Two plants, T-45-T-13 and T-45-T-11, closely resembling and initially classified as *Z. traubii*, have  $2n=48$  and  $2n=72$ , respectively. These came from a pasture in the northern part of Refugio County, where they were associated with *Z. refugiensis*, *Z. jonesii* and *Z. traubii* (Fig. 21-6).

*Distinctive chromosomes*—In general the chromosome complements of the various taxa are quite similar in appearance. There are, however, certain distinctive chromosomes in at least five of the "species" (Fig. 22-7). Certain of these occur in one or more of the recently described taxa, as well as in either *Z. pulchella* or *Z. herbertiana*, or in both of these.

*Zephyranthes traubii* shows no chromosome of singular distinctiveness. It does possess a satellited chromosome similar in size to chromosome number 2 in Figure 22-7.

#### 4. Fertility

*Seed sets.*—An abundance of viable seed is generally produced by *Z. pulchella*, *Z. refugiensis*, *Z. smallii*, *Z. jonesii*, and *Z. herbertiana*. Data on production of seed have not been obtained for *Z. traubii*, or for several apparent hybrids between *Z. traubii* and *Z. jonesii*. The artificial hybrids ( $2n=72$ ) obtained by F. B. Jones (1957) from the cross *Z. drummondii* ♀ x *Z. pulchella* ♂ readily produce viable seeds. Likewise our hybrid (No. F5A,  $2n=88-89$ ) of *Z. smallii* ♀ x *Z. brasiliensis* (Traub) Traub ♂ ( $2n=70$ ) sets full capsules of viable seeds.

*Pollen abortion.*—Approximate abortion of pollen encountered from random sampling in the Brownsville area (number of samples in parentheses) was: *Z. pulchella* (4) 1%; *Z. smallii* (4) 3-5% and *Z. herbertiana* (3) 4-6%. Random sampling of the coastal bend taxa gave these results: *Z. pulchella* (4) 11-42%; *Z. refugiensis* (4) 5-30%; *Z. jonesii* (4) 13-26%; T-45-T13 (an apparent hybrid near *Z. traubii*) (1) 67%; *Z. herbertiana* (3) 2-8%; and *Z. traubii* (1 sample of 60 grains) 6%. Jones' (1957) *Z. drummondii* x *Z. pulchella* hybrids showed 8% aborted pollen.

Considerable variation in the size of both aborted and normal appearing pollen was observed for *Z. smallii*, *Z. jonesii*, and *Z. herbertiana*. Some of the intermediates between *Z. jonesii* and *Z. traubii* are apparently hybrids between these two. This is especially true of those represented by the solid glyphs nearest T.

Variation in size of grains was apparent in samples of pollen of *Z. refugiensis* and also in that of *Z. pulchella* from the coastal bend area.

#### 5. Crossing Trials

The results of a number of attempted hybridizations between *Zephyranthes* and *Cooperia* representatives are presented in Table 3.

Of 63 attempts 17, about 27 per cent, produced seed. While comparatively large populations of progeny are available, the great majority of the resulting seedlings were still immature at the time of this study. It seems significant that approximately the same success followed pollinations between *Zephyranthes* and *Cooperia* (25%) as from cross pollinations within *Cooperia* (30%).

Table 1. Data on several characters of fall-flowering *Zephyranthes* species from the Texas coastal plains (based on 30 flowers of *Z. traubii*, and on 60 or more flowers of each of the other species). Measurements are in millimeters.

Character	Species					
	pul-chella	refugi-ensis	jonesii	smallii	herbert-iana	traubii
Ovary length	2.5-5	4.5-7	5-8	4-8	6-12	5-6
Spathe length	17-28	19-32	21-40	24-46	35-70	35-40
Spathe tube length	3-11	4-15	11-23	15-30	22-45	25-29
Maximum leaf length	370	*	*	500	600	*
Maximum leaf width	3.5	4	4.5	5	5	3
Leaf arrangement	radial	radial	radial	mostly radial	bilat-eral	bilat-eral
Primrose odor	none	infre-quent	great	great	great	great
Green color in perianth tube	great	much	some or little	some	little	little

\* Not sufficiently long under standard cultivation for valid measurements.

Table 2. Chromosome numbers of collections of fall-flowering *Zephyranthes* from two different areas of the Texas coastal plain.

Taxon	2n	Accession	County	Collector and no.
Rio Grande Lower Valley				
Z. pulchella	48	14160-57-1	Cameron	Clint T-55
Z. pulchella	48	15054-52	Cameron	Traub 3511a
Z. pulchella	48	15044-61	Cameron	Flagg T-55-P
Z. smallii	53	13175-54-3	Cameron	Flory
Z. smallii	54	13175-54-1	Cameron	Flory
Z. smallii	54	13175-54-2	Cameron	Flory
Z. smallii	54	14169-57-1	Cameron	Clint
Z. smallii	58	13070-52	Cameron	Clint T-40
Z. smallii	70	14169-57-2	Cameron	Clint
Z. smallii "major"	72	13076-52	Cameron	Clint T-56
Z. herbertiana	60	14174-57	Cameron	Clint 1021
Z. herbertiana	60	14173-57	Cameron	Clint 1030
Z. herbertiana	60	15411-61	Cameron	Clint 2951A
Z. herbertiana	68	*13066-52	Cameron	Clint T-24
Z. herbertiana	72	*13065-52	Cameron	Clint T-23
Coastal Bend				
Z. pulchella	48	15039-61	Goliad	Flagg T-52-P
Z. pulchella	48	15040-61-1	Refugio	Flagg T-53-P1
Z. pulchella	48	14446-59	Victoria	Jones
Z. refugiensis	46	13245-54	Refugio	Jones
Z. refugiensis	48	15007-61-1	Refugio	Flagg T-34-R1
Z. refugiensis	48	15025-61-1	Refugio	Flagg T-45-R1
Z. refugiensis	48	15035-61-1	Refugio	Flagg T-51-R1
Z. refugiensis	48	15041-61-5	Refugio	Flagg T-53-R5
Z. jonesii	48	15024-61-1	Refugio	Flagg T-45-J1
Z. jonesii	48	15024-61-7	Refugio	Flagg T-45-J7
Z. jonesii	48	15024-61-8	Refugio	Flagg T-45-J8
Z. jonesii	48	15003-61-1	San Patricio	Flagg T-33-J1
Z. jonesii	72	14965-61	(?)	(Traub)
Z. herbertiana	48	15051-61	(?)	Jones 4352A
Z. herbertiana	48	15004-61	San Patricio	Flagg T-33-D
Z. herbertiana	48	14995-61	Nueces	Flagg T-30-D
Z. herbertiana	48	15031-61	Victoria	Flagg T-49-D
Z. herbertiana	48	*14445-59	Aransas	Jones
Z. herbertiana	ca. 60	*14443-59	Aransas	Jones
Z. traubii	24	15026-61-2	Refugio	Flagg-T-45-T2
Z. traubii	24	15026-61-4	Refugio	Flagg-T-45-T4
Z. traubii	24	*15029-61-4	Victoria	Flagg T-47-T4
Z. traubii	(n=12)	15034-61	Victoria	Flagg T-50
unnamed: T-45-T13	48	15026-61-13	Refugio	Flagg T-45-T13
unnamed: T-45-T11	72	15026-61-11	Refugio	Flagg T-45-T11

\* Several miles outside of the ranges of *Z. smallii* or of *Z. refugiensis* and *Z. jonesii*.

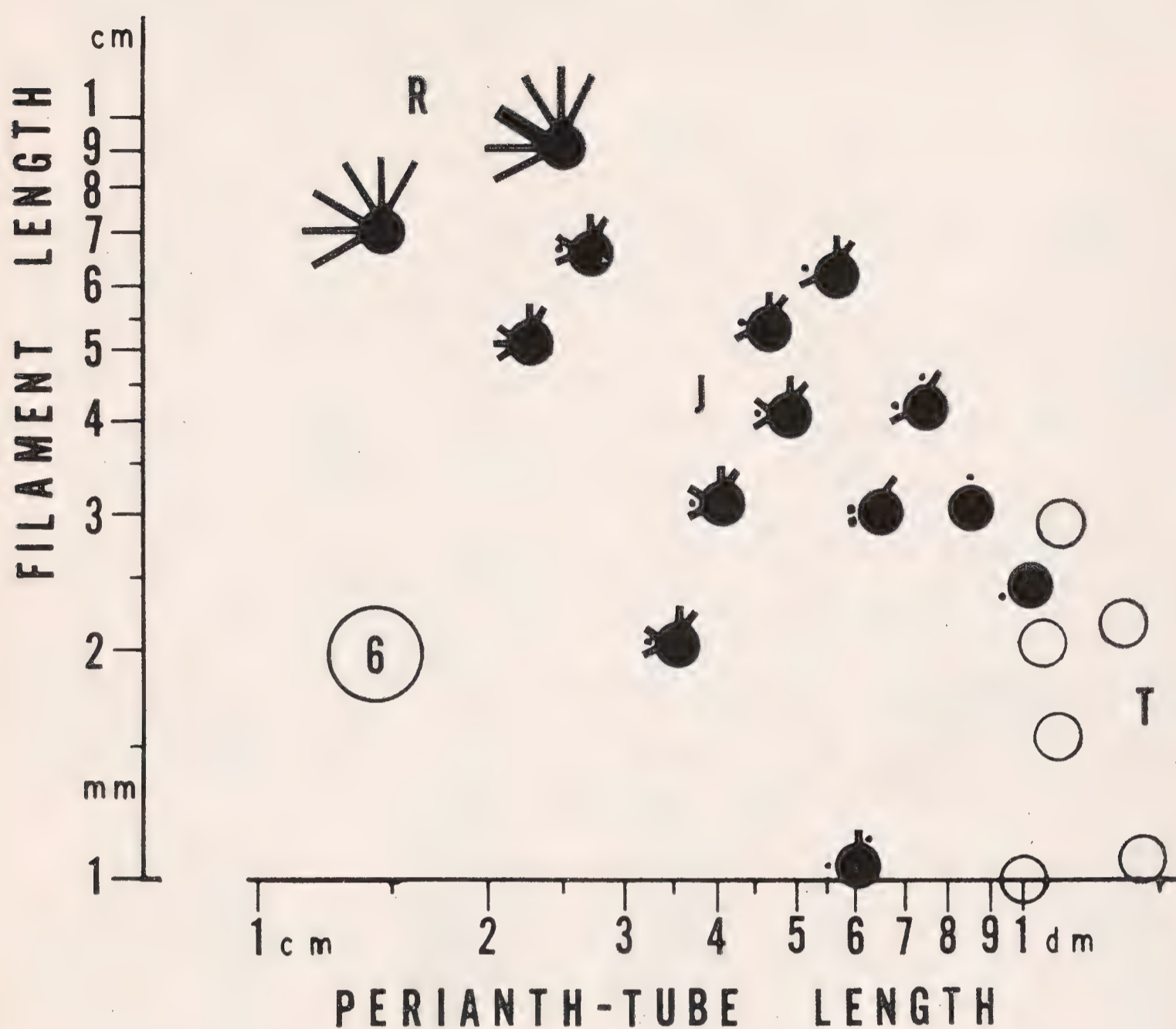


Fig. 21. Pictorialized scatter diagram (6) of representatives of populations of *Zephyranthes* from a pasture in northern Refugio County, Texas (Flagg collection T-45). *Z. traubii* (T) plants are symbolized by open circles; other symbols are as described with legend for Fig. 20-(4) and (5).

## DISCUSSION AND CONCLUSIONS

### 1. Origin of *Zephyranthes* (*Cooperia*) *smallii*

In the original description of *Z. smallii*, Alexander (1939) noted an anonymous suggestion that the yellow color of the new *Cooperia* may have come from a yellow-flowered *Zephyranthes*. Apparently considering flower color alone, he rejected the suggestion as "unnecessarily far-fetched."

While resembling *Z. herbertiana* in odor, pollen color and leaf width, *Z. smallii* is intermediate between *Z. pulchella* and *Z. herbertiana* not only in flower color but in leaf length and arrangement, position of floral buds in the bulb, time of bud expansion, and staminal characters as well as in the lengths of the pedicel, spathe, spathe tube, ovary, and perianth tube (Table 1; Figs. 19-2 and -3, 20-4). An intermediate position *per se* does not necessarily indicate hybrid origin. How-

Table 3. Results of cross-pollinations between *Zephyranthes* and *Cooperia* representatives.

Seed parent	Pollen parent	No. of attempts	No. of capsules	Offspring
Pollinations between <i>Zephyranthes</i> and <i>Cooperia</i>				
<i>Z. pulchella</i>	<i>Z. (C.) herbertiana</i>	11	1	yes
<i>Z. pulchella</i>	<i>Z. (C.) smallii</i>	1	0	none
<i>Z. refugiensis</i>	<i>Z. (C.) drummondii</i>	1	1	yes
<i>Z. (C.) herbertiana</i>	<i>Z. pulchella</i>	21	3	yes
<i>Z. (C.) herbertiana</i>	<i>Z. refugiensis</i>	1	0	none
<i>Z. (C.) drummondii</i>	<i>Z. refugiensis</i>	1	1	yes
<i>Z. (C.) smallii</i>	<i>Z. pulchella</i>	3	2	yes
<i>Z. (C.) smallii</i>	<i>Z. refugiensis</i>	1	0	none
<i>Z. (C.) smallii</i>	<i>Z. x Ajax</i>	3	3	maternals
Cross-pollinations within <i>Cooperia</i>				
<i>Z. (C.) herbertiana</i>	<i>Z. (C.) jonesii</i>	3	0	none
<i>Z. (C.) herbertiana</i>	<i>Z. (C.) smallii</i>	4	1	maternals
<i>Z. (C.) jonesii</i>	<i>Z. (C.) smallii</i>	1	1	yes
<i>Z. (C.) smallii</i>	<i>Z. (C.) brasiliensis</i>	2	1	hybrids and maternals
<i>Z. (C.) smallii</i>	<i>Z. (C.) herbertiana</i>	5	0	none
<i>Z. (C.) smallii</i>	<i>Z. (C.) jonesii</i>	1	0	none
<i>Z. (C.) smallii</i>	<i>Z. (C.) drummondii</i>	4	3	yes

ever, when the variability, ecology, distribution, season of flowering, and cytology of *Z. smallii* are also taken into account, it becomes evident that *Z. (Cooperia) smallii* is a hybrid between *Z. pulchella* and *Z. (Cooperia) herbertiana*.

Percy-Lancaster (1913, 1922, 1936) reported several artificial hybrids under the name “Cooperanthes” (*Cooperia* x *Zephyranthes*). From his descriptions (loc. cit.), and admitted lack of pollination control (1936), it is impossible to tell which species were parents of any given hybrid. This is true, at least, of those hybrids currently available. Percy-Lancaster’s “Cooperanthes,” however, obviously demonstrate hybridization between *Cooperia* and *Zephyranthes*. The high fertility in the artificial hybrids (*Z. (Cooperia) drummondii* x *Z. pulchella*) obtained by F. B. Jones (1957) indicates that crossing barriers between *Cooperia* and *Zephyranthes* are not greater than those normally occurring between the species of a single genus. The data in Table 3 lend support to such a conclusion.

The predominant form of *Z. smallii* (2n=54) apparently arose as a hybrid between *Z. pulchella* (2n=48) and the *Z. herbertiana* clone with 60 somatic chromosomes which occurs in the same Brownsville area (Fig. 22-8). Further support of the hybridity of *Z. smallii* is furnished by comparing chromosome complements. The complement of *Z. smallii* may be distinguished from that of *Z. herbertiana* by the presence of one submetacentric chromosome with a satellite on the long arm, such as occurs in *Z. pulchella* (Fig. 22-7).

The derivation of the 72-chromosome *Z. smallii* is less clear but its origin may be postulated as having occurred (1) by the union of reduced and unreduced gametes of 48-chromosome races of *Z. pulchella* and *Z. herbertiana* (2n=48), or more directly (2) from the 54-chromosome *Z. smallii* by union of gametes with unusual numbers. Variation in the size of aborted and non-aborted pollen grains suggests (Darling-

ton, 1965; Sharp, 1934) frequent meiotic irregularities in both *Z. smallii* and *Z. herbertiana*. Such irregularities were observed in *Z. drummondii* by Coe (1953).

## 2. Origins of *Z. (Cooperia) jonesii* and *Z. refugiensis*

The morphological and ecological reasons for considering *Z. (Cooperia) jonesii* a hybrid between *Z. pulchella* and *Z. (Cooperia) herbertiana* (Figs. 19-2 & 3, and 20-5; Table 1) are essentially the same as those presented in the case of *Z. smallii*. Two primary differences in the putative crosses are that they occurred in different localities (Fig. 19-1) and with different chromosome races of *Z. herbertiana* being involved (Table 2; Fig. 22-8). The 48-chromosome *Z. jonesii* probably arose from the union of gametes of 48-chromosome plants of *Z. pulchella* and *Z. herbertiana* (Fig. 22-8).

Derivation of the 72-chromosome *Z. jonesii* may be explained as resulting from the union of reduced and unreduced gametes with (1) a direct origin by self-fertilization in the 48-chromosome taxon; or with the gametes tracing from 48-chromosome plants in (2) a separate cross of *Z. pulchella* and *Z. herbertiana*; or, (3) a back-cross of *Z. jonesii* to *Z. herbertiana*. The first suggestion seems the most likely since the higher chromosome form of *Z. jonesii* has the appearance of an enlarged 48-chromosome one.

The intermediate position of *Z. refugiensis* between *Z. pulchella* and *Z. jonesii* is quite obvious (Figs. 19-2 & 3 and 20-5; Table 1). Considering its morphological intermediacy and variability, along with its ecology, distribution (Fig. 19-1), cytology (Table 2; Fig. 22-7), and blooming season, *Z. refugiensis* ( $2n=48$ ) may logically be regarded as resulting from a back-cross of *Z. jonesii* ( $2n=48$ ) with its yellow-flowered parent *Z. pulchella* ( $2n=48$ ) (Fig. 22-8). The less likely possibility that *Z. refugiensis* might have resulted from a direct cross between *Z. pulchella* and *Z. herbertiana* should probably not be ruled out. In any case, the wider distribution of *Z. jonesii* suggests that it antedates *Z. refugiensis*.

The 46-chromosome *Z. refugiensis* appears to be a direct derivative of the 48-chromosome one, although it could be the result of a separate back-cross of *Z. jonesii* with *Z. pulchella*.

Three types of distinctive chromosomes (Fig. 22-7) are shared by *Z. refugiensis* and *Z. jonesii* and *Z. herbertiana*. The distinctive type of chromosome (number 4 in Fig. 22-7) found so far only in *Z. refugiensis* and *Z. jonesii* indicates their cytological relationship. The absence of chromosome 4 (Fig. 22-7) from the somatic complements of the examined accessions of *Z. pulchella* and *Z. herbertiana* does not exclude the latter two species as probable parents. The distinctive chromosome type common to *Z. refugiensis* and *Z. jonesii* could have arisen *de novo* in the original cross. However, variability of chromosome morphology within species in the tribe Zephyrantheae is well known (Coe, 1953, 1954; Flagg, 1961b). Furthermore, relatively few of the possible parental lines in *Z. pulchella* and *Z. herbertiana* have been examined cytologically.

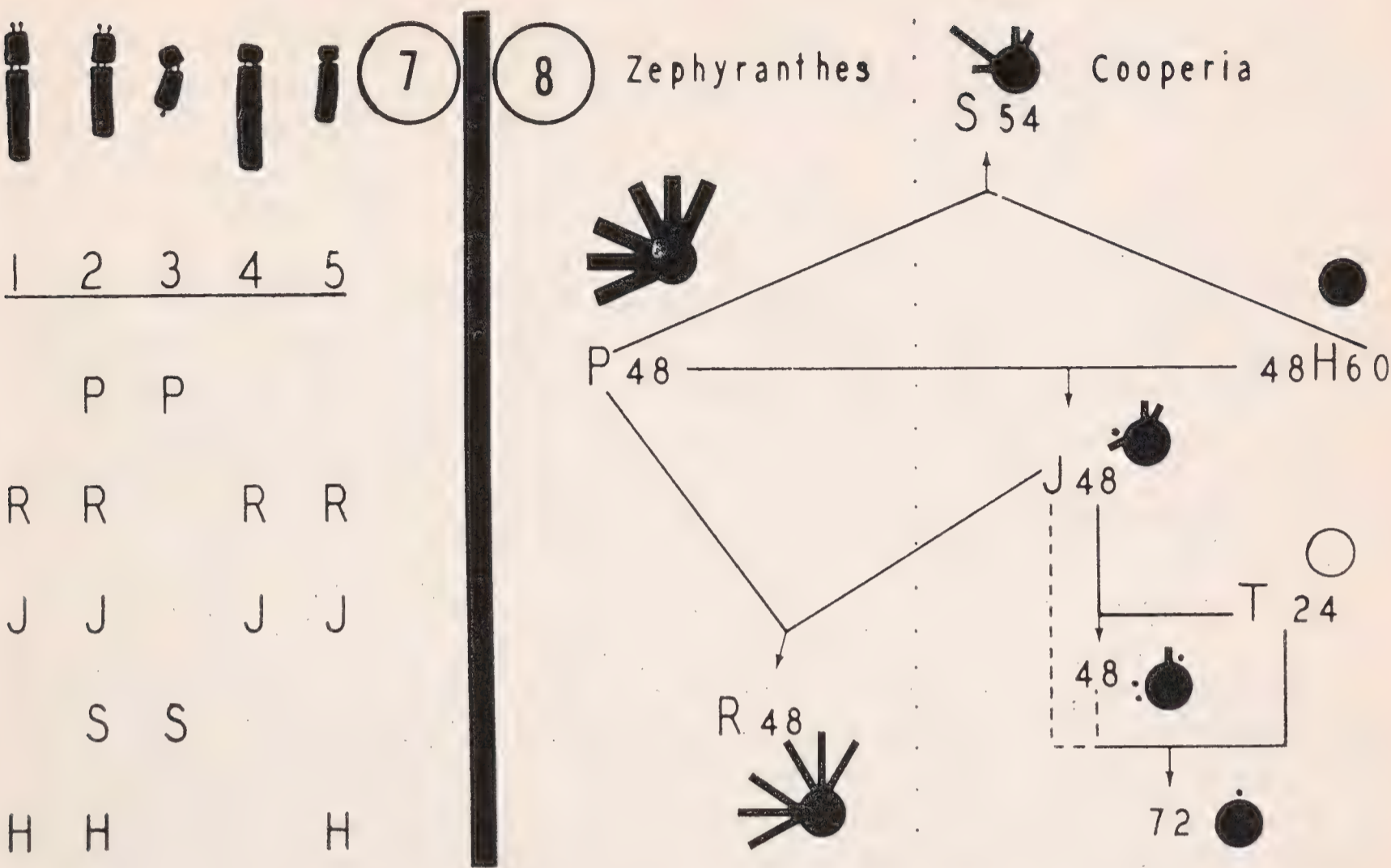


Fig. 22. A tabular comparison (7) of the occurrence of five distinctive types of chromosomes in *Zephyranthes pulchella* (P), *Z. refugiensis* (R), *Z. jonesii* (J), *Z. smallii* (S) and *Z. herbertiana* (H). Diagram (8) showing the putative origins of the three recently described yellow-flowered, fall-blooming *Zephyranthes* of the Texas coastal plain. Numerals indicate somatic chromosome numbers. Letters and glyphs have the same meaning as in Figs. 20, and 21.

3. Some Related Hybrids

In general distribution, in ecology, and in season of flowering, *Z. traubii* overlaps *Z. refugiensis*, *Z. jonesii* and *Z. herbertiana*. No location has been observed where *Z. herbertiana* and *Z. traubii* share the same habitat. The latter, however, is known to occur with *Z. jonesii* and *Z. refugiensis* in at least one location in the northern end of Refugio County (Fig. 19-1). Some apparent hybrids (T-45-T13; T-45-T11) taken from that pasture, with somatic complements of 48 and 72 chromosomes respectively, are closer to *Z. traubii* ( $2n=24$ ) in appearance than they are to any other named taxon. Their morphological distinctions from *Z. traubii* are small and include such characters as flat-subulate rather than flat-rectangular filaments, slightly shorter perianth tubes (Fig. 21-6), and perianths of somewhat smaller diameter. The significance of these differences was not realized until a cytological survey revealed the higher chromosome numbers present in these plants. There is little doubt that these are hybrids between *Z. jonesii* and *Z. traubii*. The origins of such 48- and 72-chromosome hybrids may be explained in a number of ways involving unions of reduced and unreduced gametes, or by the doubling of zygotes combining reduced gametes (Fig. 22-8).

The reflexed perianth-segments and the exserted stigmas of the larger forms of *Z. jonesii* might suggest that *Z. traubii* was one of the antecedents of the former. However, the larger forms of *Z. smallii* in and around Brownsville also have reflexed perianth-segments and exserted stigmas even though they arose nearly 200 miles from the distributional area of *Z. traubii* (Fig. 19-1).

Unlike *Z. herbertiana* of the coastal bend and Brownsville areas, *Z. traubii* has not been found in close association with *Z. pulchella*. Distributions (Fig. 19-1) and ecology would indicate that *Z. jonesii* and *Z. refugiensis* migrated into the range and habitat of *Z. traubii* rather than from it. Further, the percentage of aborted pollen (67%) found in T-45-T13 might indicate pronounced cytological differences between *Z. jonesii* and *Z. traubii*.

#### 4. "Specific" Boundaries

*Zephyranthes pulchella* and *Z. herbertiana* have apparently hybridized under natural conditions on at least two occasions. The wide phenotypic differences between the parental species, associated with heterogeneity and polyploidy of each, has resulted in their natural hybrids being quite diverse. In spite of variability, any two of the taxa, *Z. pulchella*, *Z. refugiensis*, *Z. smallii*, *Z. jonesii* and *Z. herbertiana*, are at least as easily distinguished from each other as are many generally recognized species of *Zephyranthes*. "Specific" boundaries of these five taxa are apparently sustained by polyploidy, apomixis, and strong tendencies toward self- and "intraspecific" fertilization.

Pollen is shed before or shortly after floral expansion. In general, the stigma is below or among the anthers. Plants with greatly exserted stigmas make up minor parts of populations of *Z. jonesii*. The same is sometimes true in *Z. smallii* and *Z. herbertiana*. In these three cooperias some forms with shortly exserted stigmas occur; usually elongation of the style after floral expansion forces the stigma through the fasciculate anthers and self-pollination is automatic. Copious seed production indicates that self-pollination in the five taxa leads to self-fertilization. This is supported by Coe's (1953) observation for *Z. (Cooperia) drummondii* that "in unfertilized ovules . . . the ovule degenerates before maturity." We have never seen seed develop in members of the tribe Zephyrantheae when pollinations were prevented.

The fragrance of the cooperias, as well as flower conspicuousness and concurrent flowering seasons would apparently encourage the activities of insects with respect to cross-pollination. However, differences in the time of day of floral expansion may act as a counterbalance so that cross-pollination would tend to be "intraspecific" rather than "interspecific."

Parthenogenesis has been known in the tribe Zephyrantheae for some time (Pace, 1913; Flory, 1939). From results of cytological and embryological studies, Coe (1953) reported that *Z. drummondii* and *Z. herbertiana* are apomicts. Our artificial hybrid ( $2n=88-89$ ) between *Z. smallii* ( $2n=54$ ) ♀ and *Z. brasiliensis* ( $2n=70$ ) ♂ undoubtedly resulted from the fertilization of an unreduced egg. When to these

facts are added the maternal progenies of *Z. smallii*, the total is suggestive of *Z. smallii* being an apomict, also. Evidence is not available on the presence or absence of apomixis in *Z. pulchella*, *Z. refugiensis* and *Z. jonesii*.

#### SUMMARY

The white-flowered *Zephyranthes* (*Cooperia*) *herbertiana* and the yellow-flowered *Z. (Zephyranthes) pulchella* are both widely distributed over the Texas coastal plain. Evidence of several kinds indicates that different forms of these two taxa hybridized to produce the two yellow-flowered cooperias, *Z. smallii* and *Z. jonesii*, as well as the more recently described *Z. (Zephyranthes) refugiensis*.

*Zephyranthes smallii* originated in, and is yet restricted to, the Brownsville, Texas, area. Most plants of *Z. smallii* have 54 somatic chromosomes and quite evidently originated from a cross, or crosses, between *Z. pulchella* ( $2n=48$ ) and the 60-chromosome race of *Z. herbertiana*.

*Zephyranthes jonesii* and *Z. refugiensis* arose about 125 miles farther north, on the Texas coastal bend. Both usually have 48 somatic chromosomes and trace from the typical *Z. herbertiana* ( $2n=48$ ) and *Z. pulchella* ( $2n=48$ ). *Zephyranthes refugiensis* ( $2n=48$ ) is apparently a back-cross derivative of *Z. jonesii* with *Z. pulchella*.

All three derivatives are shown to be intermediate between the putative parents with respect to a number of different characters.

Data from additional hybrids, both controlled and putative natural ones, lend support to the general hypothesis. Results of this study not only point to the hybrid origins of three recently described taxa but also lend support to the inclusion of *Cooperia* in *Zephyranthes*, and indicate the evolution of a syngameon (Grant, 1957) of the fall-blooming *Zephyranthes* of the Texas coastal plains.

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The writers are indebted to Mrs. Morris W. Clint of Brownsville, Texas, and to the late Mr. Clint, and to Mr. Fred B. Jones of Corpus Christi, Texas, for their interest, generosity and assistance with many phases of this study. All have freely shared their bulb collections and field notes, have contributed generously—both through personal discussion and correspondence—from their wide knowledge of the *Zephyranthes* populations of the Texas coastal plain, and have aided our own field studies in many ways.

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## ZEPHYRANTHES BREEDING

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*Zephyranthes* lend themselves to breeding experiments as freely as anyone might wish or expect. The basic colors found in the species are in shades of pink, yellow and white. There are a very few notable exceptions of course, but basically one must begin with the three basic colors. By crossing one color with another, we can expect a certain percent of new color combination, and/or lighter intermediate shades. The F-1 generation can be full of surprises, but the real color breaks follow in later generations.

I began my breeding program in the primary quest for new colors such as S. Percy Lancaster had done earlier in this century in India. My own breeding program began in 1952 after a new group of *Zephyranthes* collectors and enthusiasts such as Mrs. Morris Clint and Fred Jones had shared a lot of newly discovered material with me. My first major effort in starting my collection was helped by bulbs purchased from Wyndham Hayward. I bought a bulb or more of just about every kind he could spare. My collection at that time consisted of the usual "standard fare" of species for that period . . . *Z. citrina*, *Z. rosea*, *Z. candida*, *Z. macrosiphon*, and a few Florida species that I could not flower in San Antonio at that time. Mrs. Clint was kind enough to send me a single bulb of *Z. Clintiae* . . . a rare gem, and

Fred Jones sent *Z. pulchella* and *Z. jonesii*. Dr. Traub benevolently sent seed of *Z. smallii* and *Z. brasiliensis*. Thus the subgenus *Cooperia* was included in two new yellow species that had never been used by earlier breeders such as Lancaster. To these I also grew two other old-time favorites of the subgenus *Cooperia* . . . *Z. herbertiana* (syn *C. drummondii*, *Z. brazosensis*) and *Z. drummondii* (syn. *C. pedunculata*). I also had a few *Habranthus*,—*H. texanus*, and *H. robustus*, but decided not to use *Habranthus* in my breeding program.

My first efforts were to obtain the old classic *Cooperanthes* hybrids of Mr. Lancaster in India. I thought I might save a lot of time and effort by starting with his hybrids and then begin infusing the “fresh blood” of the many newer species into them. The idea seemed to make sense as a time-saver. I wrote to Mr. Lancaster and discussed this with him, adding that I would particularly like to begin with his more unusual shades of salmon, apricot, orange, etc. . . . what he had termed his “sunset” colors. He promised to dig and send me a start of these and later wrote that he had shipped them and that they were on their way. Something must have gone wrong as they never arrived. To say that I was disappointed would be an understatement. I resolved then and there that I would go ahead anyway and begin from scratch in my own way. I had seen a few of Lancaster’s hybrids that I had obtained through Wyndham Hayward, and while I thought they were very nice, there was an element missing in them that was hard to define. A lot of them had strong characters of *Z. drummondii* (*Cooperia pedunculata*) which gave them good size, but robbed them of the beauty found in the stamens and pistil. The reproductive organs of *Z. drummondii* are buried in the throat, and while it can add to the species’ charm, it does not do so in its hybrids. Then there was the pollen color problem. Unlike the mainstream species in the *Zephyranthes*, most members of subgenus *Cooperia* have white or pale yellow pollen instead of the bright yellow, or orange-yellow pollen of the others. Pollen color enhances the overall beauty. I found I also preferred a long style with towering stigma to a short shubby one as this added gracefulness. I did not like the fact that most *Cooperia* did not hold up well in afternoon sun and heat like the other rain lilies did.

Thus I resolved to concentrate on the day flowering *Zephyranthes*, at least initially. I wanted a hybrid intermediate between the deep rose of *Z. rosea* and the bright yellow of *Z. citrina*. I envisioned some sort of orange or copper colored flower in my first attempt. I used *rosea* as a seed parent and got a variety of pink flowered hybrids. All attempts at using *citrina* as seed parent yielded only maternal plants, presumed to be parthenogenic. My two best F-1 hybrids were a deep rose of medium size and great vigor was dubbed ‘Ruth Page’. A second seedling, ‘Eubank’, was a bit lighter in color with a whiter throat and lacked the vigor of ‘Ruth Page’. Both proved fertile to the pollens of almost any Rain Lily. As I was hoping for a color intermediate between yellow and rose, I was initially disappointed with ‘Ruth

Page', later to be given an Award of Merit, and classified as the first hybrid of *Z. x ruthiae* [*citrina* x *rosea*] as it failed to give me the color I sought. Perhaps I should have repeated the cross a few more times as years later the late Alex Korsakoff crossed *citrina* x *rosea* and got a very nice intermediate colored hybrid having both rose and yellow pigmentation overlapping in the same flower which he called 'Ellen Korsakoff'.

Having found that 'Ruth Page' was fertile I began using various pollens of all available yellow species on it, still determined to get the illusive orange flowers in the second generation. I used pollens from *Z. citrina*, *Z. pulchella*, and then decided to delve into the yellow flowered new members of the subgenus *Cooperia*, *Z. smallii* and *Z. jonesii*. This was a concession I thought, but I was not retracing the steps of S. Percy Lancaster. Thus I was still pioneering along a new path, which is what I was determined to maintain until I could study the fruits of my endeavors. To these four yellow Rain Lilies I also added a fifth member, an undescribed Mexican light yellow-fl'd species collected halfway between Valles and Tamazunchale on the Pan American Highway in 1953, and dubbed the "Valles Yellow", collection number 53-1.

All five species yielded hybrids on 'Ruth Page', and gave me a variety of distinctive hybrids.

Table 1.

'Ruth Page' x 53-1 sp. "Valles Yellow"—	'Texas' Large light yellow veined pink
'Ruth Page' x <i>Z. smallii</i> var. major—	'Kitty Clint' (large lt. yellow)
'Ruth Page' x <i>Z. smallii</i> var. minor—	'Fireball'—small burnt orange-red
'Ruth Page' x <i>Z. smallii</i> var. minor—	'Isabella'—pink hybrid form of <i>Z. smallii</i>
'Ruth Page' x <i>Z. smallii</i> var. major—	'Starfrost'—pink form of <i>Z. smallii</i> major
'Ruth Page' x <i>Z. pulchella</i> —	'Apricot Queen'—Clear apricot. Medium sized fls.
'Ruth Page' x <i>Z. citrina</i> —	'Peachy'—small peach-pink fls. in abundance.
'Ruth Page' x <i>Z. smallii</i> var. major—	'San Antone'—copper with yellow throat.
'Ruth Page' x <i>Z. jonesii</i> var. major—	'Betty Alvey'—Salmon with yellow keel and throat orange-yellow pollen and form like <i>Z. jonesii</i> .

As will be seen, a variety of shades in the spectrum between yellow and rose came into being. Some had yellow only in the throats, some were keeled as well, and many had complete merging of the pink and yellow pigments. When these second generation crosses were in turn pollinated with other species and between themselves, many more interesting new shades erupted upon the scene and it would be impossible and impractical to list them all as they are endless.

Several new lessons were learned. All yellow species were "faders" save *Z. pulchella*, and this fast-fading tendency was passed onto the hybrids. *Z. citrina* is intermediate in its fading, and it is less noticeable than *Z. smallii*, *Z. jonesii*, and the yellow species 53-1. But only *Z. pulchella* has real depth and intensity that holds up into late afternoon in hot summer sunshine. Hybrids of *Z. pulchella* held up wonderfully compared to the others in the afternoons, but they required considerably more water to shock them into flower and they normally began flowering later into the summer.

Hybrids of *Z. jonesii* likewise began late in the summer, and shared cultural problems somewhat like those of *Z. pulchella*. But the hardiest

and most free flowering hybrids came from *Z. smallii*. These were tough, could withstand extremes in temperature, droughts, and floods with impunity. They began flowering early and continued until late. The large flowered form has longer segments and thus are inclined to appear a bit more narrow-petaled in the hybrids and this is a fault, but by careful selective breeding in following generations it can be conquered. The small flowered form of *Z. smallii* has broader more rounded petals in its offspring but the flowers are smaller. The important thing about *smallii* hybrids is their remarkable vigor and free flowering habits. Thus the trio of *rosea*, *citrina* and *smallii* formed the cornerstones for my hybrids. To these were added other species from time to time, but every species had at least one if not two of the above trio in its ancestry.

In the third and fourth generations new colors sprang forth, such as deeper and richer orange-copper hues, deep shades of red, and interesting pastel shades and combinations. First there were bicolors, then tricolors and eventually quadricolors. Because of *Cooperia* subgenus parentage many flowers remained opened both day and night. Normally members in the subgenus *Cooperia* open in the afternoon or evening and are mostly considered night bloomers. But when hybridized with *Zephyranthes*, they may open anytime between early morning and mid-day.

I learned that some hybrids produced maternal offspring no matter what kinds of pollens were applied to them, and I soon avoided them as seed parents. 'Apricot Queen' was a good case in point. I grew many seedling to maturity in less than a year only to find all were identical to the seed parent. It was not a total loss, as I found it could be propagated in quantities quickly if desired. In effect I had artificially produced potentially new "species".

I made many other interesting hybrids as well, such as combining the genes of *Z. pulchella* with the old classic hybrid "Ajax" (*candida* x *citrina*) and these were a tremendous improvement with their deeper richer yellow flowers. In one instance I got a flower nearly exactly like the *Z. pulchella* parent, save that it was pure white like its *candida* grandparent. I named this 'Wyndham Hayward' in honor of this late famed horticulturist. Indeed I was so glad to produce the many interesting colors that I named quite a few of them for horticultural friends. Some of these folks were flattered and a few were disappointed. Apparently they expected a super flower to bear their name rather than a small Rain Lily. What I was not always able to communicate was the fact that I was placing color as my main consideration. Size and form would have to be bred in at a future time. At this writing *I have no regrets about my priorities. Were I to repeat the experiment* again I would still place color as my first priority, followed by vigor, free flowering habits, hardiness, then form and size, in that order. While *Zephyranthes* flowers are individually very beautiful, their forte is that they can flower in large masses, and this is where they make their greatest impact in a garden. Thus if the color is good, they will add

to the landscape effect from a distance.

Eventually size and form came too, and when combined with clear strong colors, one could not wish for more beautiful garden effects. The largest flowers exceeded three inches in diameter, and a few were 4-5 inches across. 'Big Shot' was the champion with flowers often five inches across. 'Texas' had good four inch flowers and these were often on stems 16" tall. 'Fire Ball' was tallest with flowers up to 18" tall. It also holds my all-time record for number of flowers scapes produced from a single bulb in a single season . . . nine.

Ordinarily I would never try to "clock" the performance of one of my hybrids, but this 'Fire Ball' caught my eye when it produced a twin flowered scape for its first flower of the season. It had done this the year before as well so I decided to place a marker beside it in order to identify it from the other "FIREBALLS" in the planting. When it flowered again the second time, the scape was a normal single flowered one. The third scape was again twin flowered. This alternated the entire summer between a twin flowered scape and a single flowered scape . . . four each until on the ninth effort, the scape had three flowers! At this point it no longer resembled a *Zephyranthes* but looked like a miniature *Amaryllis* of some kind! The following year this same bulb reverted back to its normal pattern and produced only single flowered scapes. Never again has this hybrid, or any other for that matter, produced so much as a twin flowered scape.

A tendency toward doubling also occurred in some of the hybrids, and a few varieties, such as 'Twinkle', more frequently than not had an extra 2-4 petals which added to their charm. While I don't mind truly double flowers, I have always felt that a Rain Lily with 8-10 petals looks sort of absurd, but to my surprise I found that others don't share my feeling in this regard. Indeed I have been encouraged by very knowledgeable gardeners to strive for those with the extra petals as they insist that this increases their garden value. Though I don't agree I find it is an interesting point of view.

The most "double" rain lily I ever saw was in a field of *Z. smallii* var. minor in the outskirts of Brownsville. This specimen had twelve petals and truly looked like a small yellow Camellia. Another record holder in my experience was a single bulb of the species 53-1 ("Valles Yellow") which at one time pushed up five separate scapes simultaneously. Its flowering appeared to be that of a clump, but it was only a single bulb. It was a sight not to be forgotten. Thus when these various species are incorporated into the hybrids, it is easy to see that many strange phenomena will occur from time to time as they come into flower.

Before abandoning the subject of color, it is well to mention progress in the red hybrid shades. This is still in its infancy but prospects for the near future are excellent. Aside from *Zephyranthes bifolia* and a few other notable Mexican species in the minority, there are few really good deep red flowered species that approach scarlet or crimson. Extreme forms of *Z. clintiae* and other allied Mexican complexes can

fall into the dark shades approaching carmine red, fuchsia-rose, or rose red, all with purplish undertones, but very beautiful. But at Jacala, Hidalgo, Rain Lilies seem to have undergone an explosion in pigmentation. There we can find a complex of what may be only a single species in isolated and overlapping areas where can be found colors such as the basics . . . yellow, pink, and white. But it does not end there. There are also intermediate forms between these, and there are many shades of rose and red. The best red forms are a rich crimson, and these have been of some value in breeding. These have hybridized with the yellow forms to make up an interesting series of bicolors and "sunsets", as well as pastel blush-flesh pinks, etc. For convenience, I dubbed this group the "Jacala Rainbow" complex.

By using the Jacala crimson forms, I have truly exciting shades of hybrid reds, but all have so far been small flowered like the Jacala red parent. Thus in order to get new colors, we must sometimes retreat a step backward before we can move forward toward the ultimate in form and size. My best red-flowered forms in rich carmine red came unexpectedly through genes from the subgenus *Cooperia*. In about the third or fourth generation of breeding *Cooperias* with other *Zephyranthes*, sooner or later a red or near-red form is apt to suddenly appear. This was the case with 'Carmen Jones', my first really all-out good red. Its pollen was yellowish-white, showing its kinship to *Cooperia*, but the flower was of fairly good size and fairly nice form. The color was especially beautiful shortly after opening, before it began to fade. When it was crossed with other things, a variety of hybrids, good and bad came forth. The genes are recessive and it takes a lot of breeding to bring out red flowered hybrids when outcrossed, but a few will appear. When selfed, seedlings of 'Carmen Jones' are nearly maternal. The finest step forward from 'Carmen Jones' was 'Red Witch', an ethereal beauty of rich carmine, but with a hazy picotee pattern of near white around the edges. The flower was fairly large as this color group goes, and was excitingly showy and beautiful. Unfortunately I somehow managed to lose it one winter and have since been plagued with pangs of guilt. What a pity. I also lost 'Steve Lowe', a fantastically gorgeous rose-red of medium large size, and perfection in form realized. The flower was at least as large as 'Ruth Page', but the color was richest rose red, with large, blunt, overlapping petals. One could not wish for a better *Zephyranthes* hybrid. But this too went the way of 'Red Witch'—in refining my best colors, I was losing vigor and hardiness.

In 1962 I added a new species from Mexico into my hybrid mix . . . 62-1 "Horsetail Falls", an early flowering large flowered pink from the Sierra Madre range just south of Monterrey, Nuevo Leon. This species is outstanding for several reasons: it is the earliest of all the Mexican species to flower in our area, flowering along with *Z. atamasco* here in March, April, and May, depending on the weather conditions. Because it is the nearest pink flowered species to our borders, it is

extremely hardy, and this is very important. The flowers are fairly large and of very good form with overlapping segments. Foliage is very broad and flat and it can perhaps make the largest bulbs in the *Zephyranthes* genus . . . nearly as large as baseballs when grown under optimum conditions. Though it rarely forms offsets, it will easily re-seed itself and thus is easily propagated. When crossed with hybrids such as 'Ruth Page', the seedlings in the first generation carry most of the characteristics of "Horsetail Falls" but they increase easily by offsets and flower over a much longer season. The form is essentially the same, but there is more variety in the many shades of pink and rose. These F-1 "Horsetail Falls" hybrids are fertile and the F-2 seedlings are similar but even more varied and interesting. I feel that an entire new strain of *Zephyranthes* can be had by breeding this species into existing hybrids. The foliage of these hybrids will be very wide and flat, and flowers will be rounder in shape and with segs very overlapping. Good hardiness and resistance to drought will be an extra benefit. In short, it can fill the same role as *Z. rosea* did, but flowers will start much earlier in the year, and hardiness will be much improved.

I once tried to make a series of crosses between 'Texas' and *Z. howardii* in order to obtain a new strain of super yellow flowered hybrids. Seedlings were very slow, but finally flowered in four years. They had most of the characters of *Z. howardii* in leaf and flower, but were not unusually large nor exceptional. 'Texas' had been used as the seed parent.

It will be noticed that *Z. grandiflora* was conspicuous by its absence in my breeding program. This was an arbitrary decision on my part. I had made up my mind from the start that I would not use either it or *Z. drummondii* (syn. *Cooperia pedunculata*) simply because it was much too obvious, natural, and unchallenging. I was trying to break new ground apart from the work of Mr. Lancaster and I planned to tough it out as long as I could. When I finally did cross *Z. grandiflora* with 'Texas' and 'Ruth Page', I was disappointed. Seedlings were varied but most unimpressive. I really had expected better.

Mixing the many genes in *Zephyranthes* results in the duplication and near duplication of unrelated existing species. A good case in point was 'Mockingbird', which mimicked *Z. grandiflora* in everything except the exact shade of rose-pink. The flower was the same size, same form, same foliage, etc., but there was not one drop of "blood" (genes) from *Z. grandiflora* in it. By intercrossing the hybrids enough, I was in effect coming up with a lot of artificial duplications of existing species without having to actually use them in breeding.

Our San Antonio climate is favorable for growing most *Zephyranthes* species outdoors and thus I never bothered much about hardiness as a factor to be considered in my initial attempts at breeding. I usually lost seedlings every winter, but considered those that lived as a survival of the fittest. This was unfortunate as I lost a lot of potentially beautiful things. The species of the West Indies are espe-

cially tender, and so are some of the Mexican species. Were I to begin a new breeding program I would make it a point to incorporate hardiness as a standard. There are plenty of hardy species and the tender ones should be intercrossed with the hardy ones rather than intercrossed among themselves. A tender species like *Z. rosea* should never be crossed with another tender species or hybrid unless such hybrids are intended for greenhouse culture. 'Ruth Page' and its offspring were successful because *rosea* was bred with a much hardier species, *citrina*. *Zephyranthes* are found from hot dry sea-level prairies to alpine conditions where summers are cold and damp. Hybrids can conceivably be bred for almost any altitude. My own hybrids were bred for our San Antonio area, but had I lived in San Francisco or Denver I think I could have bred those alpine species that like cooler summers similar to the Mexican plateau and highlands that would thrive outdoors where summer temperatures don't soar as high as they do in our area. Then there are the desert species that do very poorly here, such as *Z. longifolia* and a few other allies. These could certainly be bred for areas of West Texas, Southern New Mexico, Southern Arizona and Southern California. The possibilities are endless. I have grown a most varied sampling of Amaryllids and other bulbs since I became obsessed with botanical excursions in quest of new and rare species, and in hybridizing new and rare things, but I am firmly convinced that if I could restrict myself to only one group of bulbs, I would unhesitatingly choose the Rain Lilies. They are the *creme de la creme* of Amaryllids. The brightly colored miniatures that will work themselves into frenzied exhaustion during the warmer months of every year in order to flower in my garden. They are easily hybridized, and they grow quickly to maturity in 2-3 years (sometimes in but one year!), and then begin forming offsets to make a respectable clump. The color combinations and forms are without end, and nearly all please the senses. One need only obtain a half dozen or more species and hybrids to become "God" and create one's own floral critters. It is educationally fulfilling and a most rewarding experience. It has been gratifying to see my own Howard hybrids widely grown around the globe and complimenting the older Lancaster hybrids. Perhaps now is the time to wed the two strains in order to get those elusive super flowers with the perfect form, great size, and dazzling colors.

As for the future, I think there will always be room at the top for really outstanding clones worthy of bearing a clonal name. But most seedlings would be better utilized as color-strains . . . good yellows, good pinks, whites, reds, oranges, etc. There are many still elusive ideals that should be strived for. We need really great yellow flowered hybrids with BIG flowers of very good form. Existing yellow species are small flowered. 'Kitty Clint' is a larger-flowered yellow hybrid, but the color fades and the segments are rather narrow. All my orange flowered efforts have been very nice, but small flowered. The trick now is to work for the same colors in a larger flower. I purposely neglected breeding for white flowered hybrids and this was a mistake.

We can certainly use a few really outstanding white ones with all the other good qualities. The rose and pink shades are easily obtained and should be explored more fully. I purposely neglected them, but that means that others can work them for better size and form. The red ones are extremely exciting, but need a lot of work to bring them up to the level of the others. Tricolor and quadricolor combinations are exciting too. Unusual color patterns, like the picotee 'Grace Primo', which is essentially a light yellow flower with a rose-pink border, are very beautiful and unusual.

Cultural problems: One might conclude that *Zephyranthes* are the ideal garden flower, and in a way, they are. I could not imagine not having their lush warm colors splashing in profusion in my flower beds, but they have one major drawback that can't be overlooked. Their foliage is low, narrow and grass-like, which makes weeding difficult. Their foliage is attractive enough, but weeding must be frequently and painstakingly done by hand at regular intervals. *Zephyranthes*, being sun lovers are easily overgrown with all kinds of weed grasses, etc. and then they will sulk and flower poorly. I have found the best solution to the problem is to sterilize the beds in advance with a good soil fumigant. This tends to hold off the weeds for one growing season at least. After that, one must weed religiously, or remove all bulbs and refumigate on an annual basis.

Another problem is that many of the more robust growing species and hybrids tend—with the wink of an eye—to quickly spill over into places other than where they were originally intended. This can create lovely garden effects but can wreck havoc where named varieties are to be maintained separately. They can easily be grown in pots and will thrive easily if given a good soil and adequate moisture. I have found that they are very nice in flats, where quantities of them can be concentrated. I like using large styrofoam containers used for shipping tropical fish. This gives them all the room that they need and yet isolates them from one another and from the excessive weeds which will come along sooner or later. But they are at their best in the garden, in beds containing many clumps or colonies in all the various colors.

## BREEDING BEHAVIOR OF DIPLOID AND POLYPLOID CRINUMS

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The genus *Crinum*, which contains some 150 or more species, is widely distributed throughout the tropical and subtropical world. Many species have a basic chromosome count of  $2n=22$ , but there are triploids, tetraploids, hexaploids and other combinations on record. Several of the latter along with polyploid hybrids are in garden use. Recently it was found that both diploid and polyploid species as well as the hy-

brids produced a high incidence of parthenogenetic seeds. Other abnormalities such as androgenetic male seed have been noted. Since little is known concerning all of these complexities which crop up during plant breeding a brief summary of findings is presented.

In general no set rule can be given covering the normal crossings of diploid *Crinum* species. The crossing of widely unrelated species may suggest no particular problem whereas closely related species can fail. This is assuming proper temperatures and humidity existed at the time of pollination. If a fair supply of F-1 seed appears it may yield semifertile F-1 hybrids; if few seed, then one can anticipate sterile hybrids. Some plants like *C. pedunculatum* yield nearly complete or complete crops of maternal parthenogenetic seed. The above results depend upon the species, subspecies or even clones involved. The fertility of most F-1 hybrids is quite limited. Their pollens will often take on the parental species but selfing or outcrossing with other viable pollens often results in parthenogenetic seedlings resembling the maternal F-1 plant. Few F-2 seedling plants have much vigor. However, there are some exceptions.

Intraspecific crosses between *Crinum* subspecies often reveal many unexplained incompatibilities, particularly between the various forms of *C. moorei*, *C. bulbispermum* and *C. americanum*. Yet all of these species will outcross onto the others cited. In complete contrast the variants of *C. macowanii* will cross with great freedom and set generous quantities of vigorous seed. So we can conclude that most incompatibilities between species and subspecies are genetic in nature and that genetic isolation between subspecies in lieu of geographical isolation counts heavily in the evolution of newer *Crinum* types. As a consequence we find some difficulty in applying Jens Clausen's definition of a species and ecospecies to a number of these plants.

Triploid *Crinums* are sterile, we have the species *C. augustum* as a typical example with  $2n=33$ . The same with triploid garden hybrids (allotriploids of the AAB composition) although we would expect some pollen fertility at times. The tetraploid forms of *C. moorei* and *C. bulbispermum* are large vigorous plants but difficult to outcross since they are prone to give only parthenogenetic seed, both diploid and tetraploid. The tetraploid *C. macowanii* behave likewise, but will set some hybrid seed with specific parents. Thus in breeding one does better by using the pollens from these plants. The "Orange River" red-flowered *C. bulbispermum* is a hexaploid according to Dr. Fernandes. It is prone to yield small triploid parthenogenetic seed of no garden value when diploid pollens are applied but responds readily to polyploid pollens. Most of the latter crosses are huge plants with massive bulbs, foliage and flowers. Many have viable pollen but only random plants set seed and at times this is parthenogenetic. Reverse crosses of tetraploid and hexaploid species on diploid species often yield triploids of the AAB composition, as cited, or AAAB tetraploids which have some viable pollen, but only set parthenogenetic seed which is difficult to germinate. The AAB and AAAB hybrids are largely dominated by

the polyploid parent and few are of garden significance.

Two hybrids, *C. 'Cecil Houdyshel'* and *C. x burbankii* were quite an enigma as breeders until it was realized that both plants were polyploids. Presumably there was a nonreduction of chromosomes when the crosses were made originally. Selfing of either usually gives considerable parthenogenetic diploid as well as tetraploid seed. In many instances these seed result in a pure line or near pure line throwbacks to the original parental species. The normal fertility of the pure line throwback seedlings makes segregation from the semi-pureline simple as the latter are usually seed sterile. True, some hybrid material supposedly of the AAAB and AABB composition appears at times and one or two of these clones set quite a little seed. From this breeding behavior we can conclude that the Houdyshel and Burbank *Crinum* hybrids are autotetraploids and not amphidiploids, that the gamets are autosyndetic in nature and operate as AA or BB and not as AB. Outcrossing with other polyploid pollens rather bear this out after one eliminates all of the parthenogenetic throwbacks which clutter up the breeding program.

Several supposedly pentaploid hybrids exist as the result of crossing the hexaploid Orange River Lily with other tetraploid species and hybrids. The writers 'Cape Dawn' is one example, a cross which has been duplicated many times. Most of these 'Cape Dawn' siblings are uniquely similar. A few color variants have appeared but less than 5%. More variability occurs in seed production but few second generation seedlings have ever flowered or been worth keeping. Back crosses of 'Cape Dawn' onto *C. bulbispermum album* often duplicates the results of pollinating *C. b. album* with the Orange River *C. bulbispermum*. In both instances we obtain intraspecific tetraploid hybrids presumably of the ARRR composition. These plants lack hybrid vigor and the foliage and blossoms are uniquely slender, differing materially from the two parents. The pollens from these seedlings appear sterile and to date only two seed have set for me on the plants. These undoubtedly are parthenogenetic. We can only conclude that genetic incompatibilities have developed between the Orange River hexaploid form and the Cape alba form of *C. bulbispermum*. It has been the writer's hope that potent intraspecific hybrid stock could be developed as has occurred in backcrossing and interbreeding *C. x burbankii* and *C. macowanii* variants.

Several of these problems were discussed with Dr. Edgar Anderson previous to his passing away. He was inclined to compare the genetic behavior of *Crinum* to *Narcissus* wherein the gamets comprising the various species retained their entities within the hybrids with little or no pairing and exchange of chromosomes. Thus without exchange the gamets from hybrids would reappear as pure-line or near such. Under these conditions his spindle theory of hybrid parts being intermediate between the P-1 and P-2 parents fails. Typical examples would be the hybrids of *C. americanum* with *C. moorei* or *C. bulbispermum* where the features of the latter plants largely predominate in diploid crosses and completely predominate when tetraploid *C. moorei* pollens

are employed. The bigeneric cross of *Crinodonna howardii* is another example. The *Crinum* parentage is greatly accentuated in the long tepaltubes and pedicels when tetraploid *Crinum* pollens like *C.* 'Cecil Houdyshel' are employed. But despite the blossoms becoming *Crinum*-like with the double dose of chromosomes the foliage remains identical to that of *Crinodonna howardii* including the bluntly rounded leaf tips.

Numerous other examples can be given concerning polyploidy and the problems experienced. Not all polyploid hybrids make good garden plants due to their immense size and large coarse blossoms. The same applies to polyploid species recovered from polyploid hybrids. In contrast, natural polyploid species are no larger than their equivalent diploid forms. The usual distinction is much deeper pigmentation in the blossoms and unexpected yields of small runt-like parthenogenetic seed of little value. Meanwhile the search goes on for hardy free-seedling species, compatible combinations and nonsterile hybrids. The following list includes the better known polyploid *Crinum*.

Table I. Known polyploid *Crinum* species and hybrids.

- Crinum augustum* Roxb. Sterile triploid. Habitat Seychelles.
- C. moorei* Hooker. Diploid and tetraploids. Hab. Natal. Source of tetraploid form unknown.
- C. macowanii* Baker emend Verdoorn. Diploids and tetraploids. Hab. Natal, Orange Free State, So. Rhodesia. Source of tetra. unknown.
- C. bulbispermum* (Bur.) Milne-Redhead. Hexaploid. Hab. Orange Free State.
- C. yemense* Deflers. Diploid and tetraploid. Hab. Yemen highlands.
- C.* x *burbankii* (*C. yemense* x *C. macowanii*). Tetraploid. L. Burbank hybrid.
- C.* 'Cecil Houdyshel'. (*C. bulbispermum* var. *album* x *C. moorei* var. *makoyanum*). Apparently a polyploid. *C.* Houdyshel hyb.
- C. moorei* x *C. macowanii*. Hyb. Unnamed polyploid by L. S. H.
- C.* 'Cape Dawn' (*C. bulbispermum* hexaploid x *C. macowanii* tetraploid hyb.) by L. S. H. Many siblings semifertile.
- C. bulbispermum* x *C. yemense*. Numerous unnamed diploid, triploids, 3:1 tetraploid and pentaploid crosses by L.S.H. & others.
- C. macowanii* var. *gouwsii* (Traub) Verdoorn (*C. gouwsii*).  $2n=72$ . Transvaal.

**PLANT LIFE LIBRARY**—continued from page 26.

sources; a selection of perennials and their sources; and hardy ornamental grasses. The final section is concerned with planning and preparing the garden; choosing the site; sun and shade; soil and its modifications; plant division; tabular list of plants mentioned and an index to common plant names. The book is profusely illustrated, and is very highly recommended to all gardeners.

**WILD PLANTS IN THE CITY**, by Nancy M. Page and Richard E. Weaver, Jr. Quadrangle-New York Times Book Co., 10 E. 53rd St., New York 10022. 1975. Pp. i-x + 117. Illus. An original paperback. \$3.95.—The authors are known from their outstanding work at Harvard's Arnold Arboretum. After a general survey of the wild plants in the city, and directions for using the present handbook, particularly in identifying wild plants in the cities of the northeastern United States, the rest of the book deals with particular plant groups.—Description of herbaceous flower plants with other observations, and each species illustrated. The other groups, similarly treated, include, grasses and grass-like plants, trees and shrubs, and ferns. This profusely illustrated book is highly recommended to all nature lovers.

**A GUIDE TO THE MEDICINAL PLANTS OF THE UNITED STATES**, by Arnold & Connie Krochmal. Quadrangle-New York Times Book Co., 10 E. 53rd St., New York 10022. 1973. Pp. 259. Illus. First paperback edition 1975. \$4.95.—The introduction deals very briefly with the folklore and science of medicinal plants; some historical background; hallucinogens; plant identification; drug plant sources; synthetic sources; growing drug plants and words of caution about self-medication; and a two-page bibliography. A lengthy guide to the plants, pages 22 through 240, takes up most of the space. Two hundred thirty medicinal plants are considered. For each the common names, plant description, habitat, what and when harvested; and uses are given together with illustrations. Appendices 1 and 2, and an index complete the volume. Very highly recommended to all interested in medicinal plants.

**HERB IDENTIFIER & HANDBOOK**, by Ingrid Gabriel. Sterling Publ. Co., 419 Park Av. So., New York 10016. 1975. Pp. 256. Illus. \$6.95. The brief introduction is concerned with the medicinal uses and drying of herbs; the herbarium, and herb teas. Practically the entire text, pages 14 through 243, is devoted to the description of the herbs, each illustrated, some in color. For each herb the scientific name, popular name, family, range, description, elements contained, medicinal and culinary uses, are given. General, scientific name, popular name, and geographical **indices** complete the volume. Very highly recommended to all interested in herbs.

**CREATE YOUR OWN NATURAL DYES**, by Kathleen Schultz. Sterling Publ. Co., 419 Park Av. So., New York 10016. 1975. Pp. 96. Illus. \$5.95.—In the introductory section, various topics are discussed—the equipment needed, terminology, water, dye sources, preparing dyestuff and dye liquor; basic dye recipes; preparing the yarn; the dye bath and dyeing the wool. The following sections are concerned with natural dyes; experiments with natural dyes; ancient dyes; guide to dye sources and mordants. A glossary, a roster of suppliers; a metric conversion table, and an index complete the volume. Highly recommended to all interested in natural dyes.

**PLANTS FOR KIDS TO GROW INDOORS**, by Adele Millard. Sterling Publ. Co., 419 Park Av. So., New York 10016. 1975. Pp. 124. Illus. \$5.95. The author has laid out simple plant growing projects for children. For instance, with only the top parts of the carrot and beet, a sweet potato tuber, and an avocado seed, the child of very tender age may be initiated

# 4. AMARYLLID CULTURE

[ECOLOGY, REGIONAL ADAPTATION, SOILS, FERTILIZATION, IRRIGATION,  
USE IN LANDSCAPE, DISEASE AND INSECT CONTROL, ETC.]

## POTTING MIXTURES FOR AMARYLLIDS: A SUMMARY

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Mr. John Cage, in his informative article in Plant Life 31: 65-72, 1975, indicates there are many good potting mixtures for *Amaryllis*. Most of them consist of nearly identical ingredients, but usually in slightly different proportions. Mr. Cage recommends:

- 50% Mica Peat or Jiffy Mix
- 25% fine perlite, agricultural pumic or sand
- 25% leaf mold

Thalassa Cruso in a recent article about *Amaryllis* in Horticulture (Nov. 1975, pg. 34-37) suggests compost, or if this material is not available, a bag of peat moss, one of prepackaged soil, and one of perlite should be purchased along with a bottle of slow release fertilizer, preferably high in potassium. The precise proportions for the mixture were not given. She does state, however, the mixture should consist of compost, well peppered with perlite, or equal quantities of store-bought soil and peat-moss, well laced with perlite.

After much trial and error, that expert plantsman and amaryllid grower, J. L. Doran of Burbank, CA, recommends the following mixture recorded in his article in Plant Life 30: 97-103, 1974. Additionally, superphosphate and lime are added to this mixture in the amount of 1/2 teaspoon per 6" pot.

- 2 parts organic (fibrous)
- 3 parts sponge-rok #3 (coarse)
- 2 parts fine sand
- 1 part charcoal #10 (10 mesh)
- 2 parts vermiculite #3

We have used the mixture cited below with good results for potting various amaryllids and lilies.

Washed Birdeye Gravel (coarse sand)	50%
Peat	25%
Perlite	25%

To these ingredients are added about 1 tablespoon of Osmocote per pot (8"). Osmocote is a slow release fertilizer, with nitrogen, phosphorous and potassium in the ratio of 11-14-14.

It is also important to treat periodically (perhaps 3-4 times per

year) with benlate or another systemic fungicide for the purpose of controlling pathogenic root fungi.

It is obvious from this summary, the prospective grower has a choice of several good mixtures for growing amaryllids. The success of any one mixture will depend upon the skill of the grower in adapting them to his needs. It is also evident that the last word about potting mixtures has not been said. There is much room for experimentation and improvement. I should add that the selection of a suitable potting mixture is only one step in a series of operations that are needed to produce thrifty *Amaryllis* plants. As Len Doran points out in the article cited above, good management of soil moisture, soil fertility, light relationships and bulb dormancy are equally critical.

## HYBRID AMARYLLIS CULTURE MADE EASY

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Even the best of instructions one gets on growing and flowering commercial Amaryllis bulbs seem to contain pet ideas of advanced growers, ideas that are difficult for newer enthusiasts to put into practice. Where in the world can one buy thoroughly rotted manure with low salt content? To help my gardening friends, I have given them the instructions below. They seem to be reliable, and the ingredients recommended are available in almost any garden store.

Mature amaryllis bulbs will usually be received in the dormant stage, either rootless or with some live, fleshy roots. If a bulb has live roots, protect them carefully, for they are important in obtaining optimum bloom during the first season after replanting. Dormant bulbs may be stored in cool, dry vermiculite, sawdust, or peat moss for several weeks, or even several months in the refrigerator, but it is best to plant the bulbs soon after you receive them.

Best blooms can be grown in pots or other containers in a greenhouse, indoors in a sunny window, or on a protected porch or lanai. Use a pot about two or three inches larger in diameter than the bulb. Excellent drainage is essential. Bulbs can also be planted in light shade in the garden.

*Soak* dormant, leafless bulbs for an hour in a solution of Benomyl (Benlate), 1 rounded tsp. per gallon of warm water, before planting. *Wear rubber gloves.* Use same solution to water bulbs immediately after planting and once every 3 or 4 months while growing. Use same drench if you transplant growing bulbs.

*Plant* (in pots) in a good, sterile commercial mix. I endorse Super-Soil, Vitabark Potting Mix, or other light potting mix. Add about 25% clean sand if mix is not sandy or light and fibrous. *Do not add fertilizer.*

Spread any existing roots and poke some mix under the base of the bulb to avoid an air pocket, but do not pack hard. Leave about 1/2 of bulb above soil level and half inch space for watering. Keep soil *barely* moist and store at from 50 to 70 degrees F. until leaves start

to grow. Even if a flower bud emerges from the leafless bulb, just place pot in a well-lighted location and keep soil almost dry until leaves start. When leaves are growing, water fairly well, but let the soil get almost dry before watering again. Turn pot frequently to make the flower scape grow straight. *Start rootless* bulbs in warm place (up to 85°) until bud or leaves are several inches high.

In the winter, almost full sun at 70° is good until the first bloom opens; then more shade and a lower temperature will make the blossoms last longer. After the blossoms have withered, *keep the leaves growing in light shade until the following October or November*. In late Fall, stop watering and let bulb go dormant. If some leaves persist keep soil barely moist. Store cool and bring into growth gradually around Christmas time by placing in light and watering gently.

*Fertilizer.* Six weeks after planting, fertilize every two weeks during active growth with *soluble*, complete fertilizer (RapidGro) at 25% of strength stated on package. *Or* use 3 M Time-Release Tomato Fertilizer just once, scratched into soil surface. *Do not use solid fertilizer or manure.*

*Pests.* Use a rose dust or spray once a month, or more frequently if necessary, for mealybug, mites, or grasshoppers. Bait for snails and slugs.

*Virus.* Destroy any bulb with mottled leaves. At present this virus is incurable and contagious.

*Outdoor Culture.* Bulbs can be planted (with only the neck protruding) in well-drained soil outdoors in a sheltered location. Some varieties will do well. Full sun will burn the flowers. Transplant bulbs (October to December) to pots (as above) if desired for indoor bloom.

## STORAGE OF AMARYLLIS SEEDS

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*Purpose:* To see if seed could be kept in variable room temperatures by reducing humidity. (Refrigerators loaded with seeds seems to cause objections by family members.)

*Materials:* Two batches of freshly harvested hybrid Amaryllis seed. Lot 1, from a home cross of a vigorous pencilled red dutch hybrid (Onderwater brand) X Ludwig's 'Marie Goretti'. These were harvested from large fast growing pods. Lot 2, fresh seed furnished by Dr. David Bell from a dutch-mead hybrid X *A. blossfeldiae* (both tetraploids). The seeds were enclosed in small manila paper envelopes.

*Methods:* An old fashioned chemistry laboratory dessicator, 8" diameter, was on hand. This had a lower and an upper chamber, separated by a 1/4" galvanized wire mesh. 1/2 cup of granular dessicant, Drierite (Anhydrous calcium sulphate, CaSO<sub>4</sub>, W. H. Hammond Co. Xenia, Ohio), was placed in the bottom. While dry the color remains blue. When moisture capacity is reached, it signals by turning pink. The glass top was ground to make an airtight seal with the main part

of the dessicator. (An equivalent airtight receptacle could be made with a canning jar with rubber ring and screw top lid. In this instance, a layer of fluffed up cotton batting could be placed on top of the dessicant and seed envelopes on top of that.)

Many envelopes of seed were kept in this container, the top of which was removed only to put in or take out seeds.

The dessicator was kept in a kitchen closet located over a built-in oven. Temperatures (on spot checking) varied from 54° to 100° F. The closet doors were usually closed but no effort was made to insure continual darkness in the storage area.

Germination was checked by floating seeds in tap water in a lighted area.

TABLE 1. *Amaryllis* seed storage up to 16 months over anhydrous calcium sulphate, CaSO<sub>4</sub>, in a dessicator.

Seed	Time of storage	Number of Seeds	Percentage Germination
Lot 1	0 (freshly harvested)	24	83
	9 months	20	80
	12 months	16	81
	16 months	10	80
	14 months	10	70
Lot 2	0	24	79

*Conclusion:* Preliminary data shows that successful low moisture storage of hybrid *Amaryllis* seeds can be accomplished at least up to 16 months with resultant germination of at least 70 percent. The experiment should be repeated with other crosses and longer periods of storage.

## SUCCESSFUL *ALSTROEMERIA* CULTURE IN WASHINGTON

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Sumner, Washington, 98390*

For several years I have been growing *Alstroemeria* under less than ideal conditions with quite good results. Living in the Puyallup Valley south of Seattle, Washington, I have an excellent sandy loam soil but also an extremely high water table. In fact there are times during the winter when the *Alstroemerias* are covered with water for one or two days at a time. I must admit that this has caused the loss of some plants but what has surprised me most was that the majority of them have survived.

As a child, living in Newberg, Oregon, I had first seen *Alstroemeria aurantiaca* growing in my aunt's garden. Although it is often considered "common" its butter yellow flowers with maroon spots were exotic to the eyes of a young child. Years later I still feel that when grown well it is a wonderful addition to any garden. I later discovered the *Ligtu* hybrids with their glorious color range and grew these in Newberg also.

After college and a time in the Air Force, I settled on a small

farm near Sumner, Washington. I wanted to again try to grow those lovely flowers, this time with the idea of selling the cut blossoms to the florist trade. Seed was obtained from the old plants growing at my parents' home in Newberg, and were planted in 1½ inch peat pots filled with a half sand, half peat moss mix.

I have found that *Ligtu* hybrid seed planted in this manner in spring and set outside in an open cold frame will start to germinate in six weeks. As soon as they are growing well, but before they break through the peat pots, they are planted out in the field. They are kept well watered and fertilized for the first summer to get as much growth as possible. A few of them will even bloom at that end of that first season.

The *A. aurantiaca* seeds are planted in the same manner but in the fall, and allowed to remain outside in an open cold frame through the winter. They will germinate in the spring and are then planted out and tended the same as the *Ligtus*.

In our climate, one of the most critical periods is the first winter. If it is a mild one there is no problem, but if the temperature dips to near zero as it does some years, the young plants must be mulched to prevent the frost from reaching them. I do this by applying a good layer of sawdust. The next spring the plants will grow up through the mulch and by the end of their second summer they have grown deep enough into the soil that they no longer require special protection.

The cut flowers have been well received by many florists, while others are reluctant to try something new. They would rather stay on the safe side with roses, carnations, chrysanthemums and gladiolus. What a pity! The *Ligtu* hybrids come in such beautiful colors, ranging from cream, beige, cantaloupe and orange through all shades of pinks from soft shell to deep watermelon. Both the *aurantiacas* and the *Ligtus* last exceptionally well as a cut flower.

As they become better known and as some of the newer hybrids from England and Holland are introduced into the florist trade, I am sure that they will be better accepted by both the florists and the general public.

## 1975 ZEPHYRANTHEAE REPORT

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### I. THE NATURE OF RAIN LILIES

The genera *Zephyranthes* and *Habranthus* are very closely related, require the same general growing conditions and bloom according to their individual nature from early spring through fall. The flowers may be tiny (less than one inch across), medium or fairly large (three or four inches). Although deviations are known, the six petaled flowers are borne singly on petite scapes six to ten inches long or more robust

scapes of up to sixteen inches. Although *Habranthus* are usually sought for their larger bulbs and flowers, a wide range of sizes occurs in species and hybrids of both genera. The blooms last for only a few days, but mature bulbs of many popular species and hybrids will average two to three scapes per season. Each bulb will not necessarily bloom at the same time or with the same frequency. So, if groups of several species and hybrids are grown, overlapping of bloom seasons and sporadic isolated bloom will give a long cycle of activity. Flower colors range from white, yellow and pink to deeper shades of gold, apricot, orange red (rare), rose and red, with a predominance of various pastel shades in between ranges. Flower variegations are not as vivid as those found in certain species and hybrid *Amaryllis*. There are many, however, that display two or more hues and a more limited number that exhibit striped or spotted effects.

*Zephyranthes* and *Habranthus* are often called Fairy Lilies, Zephyr Lilies or Rain Lilies. These small amaryllids will bloom following a thorough watering of garden or pots, but the most magnificent profusion of bloom occurs after a good rain shower during the blooming season. A bulb desperate to bloom might rarely do so on heavy humidity alone, but buds normally appear from a few hours to a week following a shower. Perhaps you have noticed a similar phenomenon with other small amaryllids in the garden. A single clone of *Cyrtanthus sanguineus* is fondly called my "African Rain Lily." This naturalizes well in Galveston and is planted next to a rock in a garden border with bright filtered sun.

While *Zephyranthes* and *Habranthus* are native to the Americas exclusively, one can imagine the great diversity in climate, altitude and geological soil structure found in this large area. I'm sure that more than one collector of amaryllids has seen bulbs blooming in standing water, in almost pure sand and gravel or between cracks in boulders high on a hillside and has been prompted to note: "What in the world are you doing here!" Fortunately for us, most Rain Lilies are easily adaptable to home growing conditions and newly introduced species and hybrids are eagerly sought for trial.

## II. CULTURE OF RAIN LILIES

Here are the basic rules for growing *Zephyranthes* and *Habranthus*: Choose a sunny spot with loose, friable soil (sandy loam is best) that drains well following heavy rainfall. Rain Lilies are most effectively used as a border for the garden or alone in narrow beds and other confined places. They particularly enjoy growing near rocks, bricks or even cement paving. A soil pH from neutral to alkaline is generally best for most species and any good feeding program formulated for your area may be used. Actually, good drainage and light are probably more critical factors than soil or water pH for many Rain Lilies, providing the pH is close to neutral. Those of you who read Dr. Walter Flory's very popular article, *Rain-Lilies*, in the March 1975 issue of HORTI-

CULTURE may have noted the recommended general use of "somewhat acid loamy soils", with certain species requiring calcareous soils excepted. This apparent disagreement reflects local growing experiences and demonstrates the adaptability of many of these small bulbs. *Z. atamasco* needs a little richer, more acid soil. At the other extreme *H. concolor*, *Z. longifolia* and a few other species from rocky desert areas are very difficult to bloom without a very high pH adjustment (and possibly some other conditions too). Species from the West Indies and certain coastal areas also prefer an alkaline environment in order to perform best. Both Drs. Traub and Flory have written that *Z. albiella* prefers an acid soil. This must be a very tolerant species, for it receives copious amounts of hard Galveston water during extreme dry spells and blooms abundantly in the spring and early summer. *Zephyranthes* and *Habranthus* bulbs should be planted about two inches apart in the ground with the top of the neck where new leaves emerge at soil level or just slightly above. Protect from freezing temperatures. Many species of these genera are hardier than most people realize, particularly if the bulbs are mature and healthy. A winter mulch is sufficient for most all areas in the south. With prolonged ground freezing temperatures, dig and store like other tender bulbs or transfer to containers which may be protected.

For containers, use your ingenuity or stick to the standard four to eight inch clay or plastic pots. Simple planters may be constructed of redwood or cedar fencing material. The small pots are useful for a single medium to small bulb or several tiny ones. The larger *Habranthus* and *Zephyranthes* with long bulb necks will require pots with greater depth. A six inch pot will usually handle a full seed capsule for germination. To a standard potting soil mix, add an additional one fourth to one third portion of grit mixture. The best is a combination of perlite and something calcareous like crushed shells or limestone pebbles. Use mixed sizes for larger containers, if possible. Activated charcoal is great and don't forget the bonemeal. Believe it or not, crushed oyster shell is not available in Galveston nurseries. I have to gather my own small shells to add with chert pebbles. Bulbs may be planted as close as an inch apart, if necessary, and the top of the neck should be more or less at soil level. Allow plenty of room at the top for thorough watering when needed and give the pots at least one-half day's sun. If filtered sun is desired in a very hot climate, the use of deciduous trees for cover is ideal because it allows almost full winter sun. Follow a routine feeding schedule and water the pots thoroughly only when dry. You will probably find that much less frequent watering will be required during the colder months. Even evergreen bulbs should be kept on the dry side. If you suspect that hard water impurities have built up during long summer drought periods, flush the pots with four or more repeated waterings and follow with regular feeding. An occasional frost or light freeze should not damage bulbs or foliage in pots. Prolonged exposure to temperatures below 35° F. or predicted temperatures below

32° F. should probably be avoided. Weather is sometimes more severe than predicted and pots are more exposed to cold. --

*Zephyranthes* and *Habranthus* are not prone to disease. For example, they will easily pass by visual inspection of Department of Agriculture officials if the bulbs are carefully washed and trimmed. Each one of you could probably write an essay on your most troublesome chewing or trampling pest. Spring is the worst time for bud damage by snails, slugs or worms. Fortunately the foliage will recover quickly, but who wants to wait perhaps another year to see a new variety bloom. Plan a vigilance long before buds are due and by all means use sight, hands and bait—there is certainly no single solution. Snails and certain worms feed at night and moisture activates snails and slugs. If hiding insects such as mealy bugs and bulb mites are a problem, plan a followup treatment with a systemic or contact pesticide or a combination of the two. A single treatment may not be enough, particularly close to a dormant cycle or slowing down of growth activity.

Rain Lily seeds are easy to germinate if they are mature and reasonably fresh. For best results, plant seeds from one to six weeks from harvest date. They are produced in several shapes and sizes, but most are fairly flat. Certain species such as *Z. candida*, *Z. rosea* and *Z. albiella* have just a few seeds and these are quite plump and almost round when harvested. Your favorite easy method for seed germination should be satisfactory. Seeds may be started indoors during cold weather or outside in semishade during the hot season. If a plastic cover is not used, try anchoring a piece of absorbent kitchen paper towel with toothpicks. Seeds will stay in place when watered and leaves will come through the paper. First transfer if desired, may be made as soon as a small bulblet has formed (tallest leaf will be three or so inches high). When seed flats or pots cannot be elevated, toothpicks will also discourage frogs from resting among seedlings (at least this has worked so far). My seed raising experience is far from vast, but the only real difficulty I have encountered with *Zephyranthes* was with a group of seeds collected by several expeditions in the Andes. For the most part, these were rare *Rhodophiala* species and not a single one survived my methods and climate. Few *Zephyranthes* and *Habranthus* are this tricky.

If you happen to have a nice hybrid Rain Lily that sets seeds, don't hesitate to increase your stock in this manner. Chances that the seedlings will be maternal are great and poor ones, if any, may be discarded. Actually, seed selection is highly satisfactory with these genera and may be used to improve vigor in both species and hybrids. In nature there is renewal by seeds and offsetting. While this does not mean that a favorite clone will automatically go into a decline with age, you may find it happening to a few or you may possess a single bulb that does not perform as expected. (This is assuming that satisfactory care is provided and adaptability has been proven.) In 1970 we collected some *Zephyranthes* growing in very rocky limestone hills about 88

miles from San Luis Potosi on Highway 86 toward Valles, Mexico. My mother kept six bulbs to grow in Brownsville and hers never bloomed. Out of my pot of a dozen bulbs, two bloomed the following year and have continued to bloom each July. The flowers have nice *Z. macrosiphon* type form and are a pretty cool pink with a white center. Some time ago I should have raised some seedlings and discarded the other ten bulbs.

If you have tried Rain Lilies for a season or so and they are not performing as you would expect, review the basic rules and survey your growing area. Perhaps conditions have changed since the bulbs were planted. This was demonstrated recently by a knowledgeable and well known grower of tropical plants. Both Day Lilies and Rain Lilies were not flourishing at a relatively new homesite. Two trouble spots were found: Trees and shrubbery had grown more rapidly than expected, giving too much shade, and the special mixture used for top soil was probably too rich in organic matter. J. L. Doran's *Amaryllis Growing* (PLANT LIFE 30:97-103, 1974) contains many excellent basic points which may be applied to anything grown in a container. Because my gardening is on a small scale, I purchase a brand of potting soil that is consistent at a discount store and mix additional grit with it. Look for one that contains ground bark as organic matter in place of peat. Devise means of freshening the soil each year, but don't hesitate to repot occasionally. Some species in the wild grow in outlandish places and are forced to store nutrients during a rainy season. However, as Doran points out, a pot is a different environment entirely and cannot be compared to any natural habitat. Although little is known about specific requirements, don't forget trace elements in a feeding program, even in the garden. Many bulbs in the ground should not be disturbed; however, others might benefit by having their area reworked every few years. To avoid possible bulb damage, keep weeds out regularly. Bulbs may be disturbed any time during the growing season. Late summer or early fall is ideal in my climate. A final word: Rain Lilies will tolerate much neglect, many bedfellows and short periods of many extreme conditions . . . but they will not stand constant moisture, particularly combined with too much shade or cold.

### III. RECOMMENDED RAIN LILIES

Recommending a list of dependable *Zephyranthes* and *Habranthus* species and hybrids could become a study in depth for various growing areas. However, the species most commonly grown are tolerant of varying conditions, are probably pretty hardy and are usually the most available commercially:

*Z. X ajax*—This is a very old hybrid combination of *Z. candida* and *Z. citrina* and is often listed among species *Zephyranthes*. The flowers may vary a little in size, form and color intensity, but all are excellent garden bulbs for bloom during the summer and fall months. Some back crosses with both species are superior and some clones in

this group may be fertile.

*Z. candida* (subgenus *Argyropsis* Herb. ex. Ravenna)—This white species, said to have been introduced in 1515 from Argentina, blooms abundantly in late summer and fall and offsets rapidly. It is an "escape" plant in certain areas and thus is mentioned in H. W. Rickett's *WILD FLOWERS OF THE UNITED STATES, VOL. III TEXAS* and C. A. Brown's *WILDFLOWERS OF LOUISIANA AND ADJOINING STATES* and perhaps others. *Z. candida* is among the hardiest of these genera.



Fig. 23. *Habranthus brachyandrus* from Paraguay growing in a corner of a Florida garden. Note the profuse flowering from a single clump. Photo by Mrs. Gertrude Jeffrey.

*Z. citrina*—This is the most satisfactory and popular of the yellow species and comes from the West Indies. It blooms in late summer and fall, sets seed abundantly and has been extremely valuable in hybridizing.

*Z. drummondii* D. Don (syn. *Cooperia pedunculata* Herb.)—This is a very robust white species from limestone hills in Texas and adjoining areas of New Mexico and northern Mexico. It adapts well and has been useful in various scientific studies and in hybridizing. Several of the Percy-Lancaster hybrids are sometimes still available and may be listed as "*X Cooperanthes*" (*Z. X lancasteri* Traub and *X Sydneya* Traub). A discussion of these and other hybrids may be found in the 1959 issue of *HERBERTIA* (Traub, Hamilton P. Hybrids in the Tribe Zephyrantheae. *HERBERTIA* 15:37-41 1959).

*Z. grandiflora*—The bright and large rose pink flowers appear in

summer to fall on the species and it is reported to be from Guatemala as well as parts of Mexico. Most forms are self sterile, but it offsets gradually to form large clumps. It is an "escape" plant in Galveston and other places and so widely popular that it is rumored to have been successfully grown in Alaska (with some winter protection no doubt!). Sometimes listed as *Z. carinata* Herb., this lovely flower has been somewhat mimicked through hybridization of other *Zephyranthes* by Dr. T. M. Howard. It was interesting to note in Dr. Flory's article, *Rain-Lilies* (see earlier reference), that regular flowers of *Z. grandiflora* have 48 chromosomes, while forms with semi-double flowers or aberrant blooms have an odd number of chromosomes. Apparently the tendency toward aberrant blooms in other species and hybrids of these species is not necessarily a permanent feature and therefore may not be indicated in the chromosome count.

*Z. rosea*—This is another extremely popular Rain Lily from the West Indies. It was also collected by J. L. Doran in Panama. The plant is fairly small in all proportions and the bright rose flowers with white centers usually appear during the summer months. Very few small seeds are produced, but it offsets easily and makes a fine subject for pots. It blooms particularly abundantly in gardens of southern Florida and is noted for occasional blooms with extra petals. It is very valuable in hybridizing. Dr. T. M. Howard's *Z. X ruthiae* (*Z. rosea* X *Z. citrina*) has produced the Award of Merit clone 'Ruth Page' and the late Alex Korsakoff's 'Ellen Korsakoff'. Dr. Howard used 'Ruth Page' as a seed parent to obtain many other fine hybrid *Zephyranthes* of good size, form and unusual color range. With pollen from a variety of species and hybrids, he also introduced qualities such as adaptability, hardiness and quantity of bloom.

*Z. smallii* (subgenus *Cooperia* Traub)—This dependable yellow flowered species comes from a very limited area around Brownsville, Texas and will probably become extinct in the wild. Two flower sizes are known and if the form on some is not perfect, abundance of bloom more than compensates. Multiple scapes are often produced and some clones may have flowers with extra petals periodically. Season is summer to fall, it offsets gradually and is very fertile.

*H. brachyandrus* (Fig. 23)—You can't overlook this South American species in the garden. Flowers are large, trumpet shaped and vividly colored orchid pink with a flower base of dark but bright burgundy. While seed setting is unpredictable in some areas, the bulbs offset to a fault. If this hampers the summer blooming of mature bulbs, provide better drainage. Certain clones of *brachyandrus* show the greatest tendency among Rain Lilies toward odd flowers. This species suffered damage during the 1962 heavy freeze in Brownsville, although it passed through the same freeze in Houston unharmed.

*H. robustus*—Great for mass planting, this large and lovely species also comes from South America. A mixture of *brachyandrus*, *robustus* and their hybrid, *H. X floryi* can be very effective in the garden. Flowers appear in the summer and are usually three toned—lime or darker

green at the base, whitish center, then pink. They are, however, variable in size and intensity of color. This plant thrives on neglect and reproduces rapidly by offsets and seeds. With mass planting, twin flowers and some doubling may be found.

*H. tubispathus* (L.Herit.) Traub—Synonyms are *H. andersonii* (Herb.), *H. texanus* and it is sometimes listed as Texas Copper Lily. This small yellow *Habranthus* is from Texas and South America. Flowers may be flushed with reddish brown, or have a few darker striations in the center. A yellow type from South America, possibly more robust than the Texas one, is sometimes called *cupreus*. *H. tubispathus* forma *roseus* Traub was rare in cultivation a few years ago and now is quite popular, being particularly adaptable in California. Forma *bicolor* (Ravenna) Traub is still quite rare.

The following is a supplemental list of *Zephyranthes* and *Habranthus* which should be more widely grown whenever seeds or bulbs are available:

*Z. abiella*—"Little whitey", as it was named by Dr. Traub (PLANT LIFE 6: 31-53, Fig. 6. 1950) is a charming free blooming *Zephyranthes* from northern parts of South America and perhaps Central America. With small bulbs, dainty flowers and shiny foliage, it is best appreciated in a pot. It sets very few small round seeds, but offsets freely. Bloom season is spring to early summer, but it is likely to flower in late winter if the pot is allowed several months' dormant period before being placed under indoor plant lights and given water. A pink *Zephyranthes* resembling *albiella* was collected by the late Prof. Ira F. Nelson in Panama. This is thought to be a possible natural hybrid (with *Z. rosea*?) and blooms during the summer. The late Alex Korsakoff used *Z. albiella* in hybridizing and it should be tried more frequently. OK folks, how about a yellow *albiella* type, or another X. *Sydneya*?

*Z. atamasco*—This large white flowered species is native to our southeastern states from Mississippi to parts of Florida. It flourishes in a little richer, more acid soil and therefore is not as popular in areas with different soil conditions. Pot culture or special treatment is recommended as being worth the effort. The flowers, though variable, are large and well formed. Buds may be a bright rose in cool weather. It blooms in the spring, sometimes quite early, and spreads by offsets and seeds. The cool temperatures that extend the lasting quality of the flowers may also inhibit seed setting in some areas. A hybrid between *Z. atamasco* and a pink Mexican *Zephyranthes* (*Z. X flaggi*) is more adaptable than the maternal parent and Korsakoff's registered hybrid X 'Nicetria' (*Z. X flaggi* and *Z. grandiflora*) is quite lovely. *Z. simpsonii* and *Z. treatiae* have been named from restricted parts of the above general native area and these are perhaps a little more difficult to adapt. My own experience, however, is based on growing a single bulb of each.

*Z. flavissima* (subgenus *Argyropsis*) Ravenna (PLANT LIFE 25: 154, 1969 and PLANT LIFE 27: 67-68, 1971)—This yellow-flowered species is recommended with the hope that more plant material will

become available from South America for trial. For sometime I have grown single clones of unidentified yellow species from Santa Catarina, Brazil and Entre Rios, Argentina. Since *flavissima* is known from these areas and my flowers fit within the description, their identity is fairly certain. Bulbs of my two are easy to maintain, but July flowering can be notional. The deep yellow flowers are quite lovely, fairly open with evenly arranged petals. Here, it has been completely sterile, but the tiny bulbs will offset.

*Z. herbertiana* Dietrick (Subgenus *Cooperia* Traub)—Some synonyms for this fragrant little weed are *C. drummondii* Herb. and *Z. brazosensis* Traub. It is native to several of our states and further south and the small white flowers usually appear from mid-summer to fall. The ordinary variety is not a showy garden subject and it spreads rapidly by offsets and seeds; however, some special large flowered forms are sometimes available. From its natural range, this species is one of the hardiest and toughest of the two Rain Lily genera. Another white *Cooperia*, *Z. traubii*, is native to a short portion of the Texas Gulf coast. Its flowers are lovely, but it is difficult to bloom away from southern coastal areas.

*Z. insularum*—Similar in growth habit to *Z. rosea*, this small white flowering native of the West Indies is an "escape" plant from cultivation in some Mexican coastal areas, southern Florida and perhaps some other tropical places. While bloom is not quite so luxuriant elsewhere, the bulbs are easy to grow and multiply in a pot. Their flower petals are arranged in a different manner and the species is not as tender as perhaps their size, delicacy and habitat might indicate. A clump grown in the ground in Houston, Texas survived the deep freeze of 1962. A somewhat similar but more robust white species with fine flower form is *Z. puertoricensis*. This also grows and multiplies easily in a pot, but is more tricky in bloom performance. *Z. puertoricensis* was sent to Dr. Traub for identification in 1949 (PLANT LIFE 7: 37-38, Fig. 4a. 1951) by Dr. Harold F. Winters while he was assigned to Mayaguez, Puerto Rico. Dr. Winters is currently Research Horticulturist, Germplasm Resources Laboratory of the Agricultural Research Service in Beltsville, Maryland and is one of the many members of The American Plant Life Society who has submitted plant material for the study and enjoyment of all. For over one hundred and fifty years, this taxon had been erroneously labeled *Z. tubispatha* in commerce (Flory, W. S. The Chromosomes of *Zephyranthes Insularum*, *Z. Puertoricensis* and *Z. Nervosa*, HERBERTIA 15: 55-63, 1959.)

*Z. pulchella*—This bright yellow species is native to areas around Corpus Christi and Brownsville, Texas. They often seek low dry places that flood for a short time following heavy rainfall; however, they are not difficult to adapt to regular garden conditions. It blooms in late summer to fall and very closely resembles *Z. citrina*, including the ability to set a large number of seeds. Of the forms I have grown, the leaves of *pulchella* are more slender than *citrina*, the stigma is tiny for the genus and the flowers are perhaps a bit more open and refined (on the second

day). Two other yellow-flowered *Zephyranthes* grow in special areas near Corpus Christi and these have been named *Z. refugiensis* and *Z. jonesii* (subgenus *Cooperia* Traub). These two species present no special difficulties in culture and make fine additions to a collection of rare bulbs.

*H. cardenasiana*—Similar in size and growth habit to *H. brachyandrus* and *robustus*, the flowers are white with a pink flush and appear in the spring and early summer. It comes from Bolivia and a clue to its identity is the deeply cleft and slender three-part stigma. Under cultivation here, it sets seeds poorly and the blooms rarely last over a day. On the plus side, the bulbs are easy to grow and flower and it may be brought into bloom indoors in late winter.

*H. martinezii*—This new *Habranthus* was used in hybridizing by the late Alex Korsakoff as both seed parent (*H. martinezii* x *H. robustus*) and pollen parent (*Z. albiella* x *H. martinezii* = X *Sydneya* 'Teddy Buhler'). It was introduced to cultivation by Dr. Carlos Gomez Ruppel, Argentina, (Paul H. Williams, Jr., PLANT LIFE 25: 36-37, 1969) and named and described by Pierfelice Ravenna (PLANT LIFE 28: 121-123, Fig. 29a, 1972). The bulbs adapt well to ground or pot culture and increase mainly by offsets. The flowers have nice *Habranthus* form, are intermediate in size between *H. tubispathus* and *H. robustus* and are off-white in color. Base of the flower is reddish brown and green, with upper striations of pale muddy grey or pinkish grey. The bulbs bloom from spring to early summer, although late winter bloom may be achieved indoors at times following a period of dormancy.

Much has been discovered and written about the *Zephyrantheae* of the Americas; yet, there is much more to be learned. In Mexico particularly, ingrating among species is a problem for taxonomists. While most gardeners would prefer to have a proper name for his favorite plant, characteristics such as adaptability, flower production and beauty are really more important. A brief review of the *Zephyranthes* and *Habranthus* of Mexico will be attempted in a future report. In the meantime, don't hesitate to try anything listed only by a plant collection number, nickname or locality. Chances are high that these have withstood from ten to more than twenty years of cultivation in the United States and elsewhere.

#### IV. SOURCES OF RAIN LILIES

There are no commercial sources for a full list of *Zephyranthes* and *Habranthus*. Perhaps demand will improve the situation, but this will take time. Members of APLS interested in small bulbs can help by sharing and exchanging seeds by mail and through local clubs. Please remember the courtesy of a stamped self addressed envelope when requesting information from any member or officer of APLS. This may also help speed a reply.

## CLIVIA CULTURE—1976 Report

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In the few years I have been growing members of the Amaryllidaceae there is one important thing I have discovered; commercial planting mixes are generally not suited to the optimum growth of plants of this family. Perhaps others have had success with a particular mix but I have not. It took me quite a while to decide to experiment with my own mixes and therefore I am still in the experimental stage but the results look fruitful at this point.

In this article I would like to describe my experiences with the genus *Clivia*. I consider this genus the finest of the family, no offense intended to those who have preferences for other genera. Species of this genus have beautiful dark green foliage, spectacular clusters of orange or yellow flowers, and fruit which lasts on the plant for as long as a year, gradually changing color from green to red. Besides the physical attributes. *Clivia* species are of relatively easy culture as long as a few rules are followed. Because of their natural preference for deep shade conditions they are also adapted to home or porch growing.

While Clivias seem foolproof at first glance there are some rules to be followed in their culture. They should not be planted in a loose airy soil. The thick, finger-like roots need a more substantial mix. Although they thrive for a while, they may suddenly go into a decline. This is what happened to a specimen I had of *Clivia miniata* var. *flava*. Clivias tend to give ample warning when something is culturally wrong. Under pot culture they may begin to send up narrower foliage. The plants will also begin to lean over indicating that something is wrong with the root system. At this point it is suggested that the plant be repotted in a heavier mix.

It is often thought that Clivias resist being repotted frequently since they are known to flower better when rootbound. However, I have found that they are one of the most tolerant plants with reference to transplanting and if something is suspected as being wrong there should be no hesitation in unearthing the plant to check for root rot or any other problem. In the case of my *Clivia miniata* var. *flava* most of the root system had rotted away, causing the plant to tip in its pot. This plant is now growing in a mix of one part redwood compost, two parts garden soil (decomposed granite in our area), and a few pinches of bonemeal and insecticide/fungicide. I am still waiting for the results of this mix but it does look promising. One advantage of growing *Clivia* is that there is no bulb to rot away and thus leaving you with nothing. The roots may rot away under adverse conditions but I have never seen the entire basal plate disintegrate. Therefore new roots simply emerge from the plate.

Two other symptoms of improper culture have also been observed.

I believe that excess application of nitrogen fertilizer may result in abnormally long, thin, weak leaves. Also, strangely undulated leaves have emerged at times. This could be due to a variety of reasons.

Among the species I am currently growing are *Clivia caulescens*, *C. miniata*, *C. miniata* var. *flava*, *C. nobilis*, and an unidentified species which will be described more fully at the end of this article.

Clivias thrive outdoors in the open ground in this area. All they require is rich soil, shade, and ample moisture. Even if these requirements are not met they will still endure. In poor soil the roots remain close to the surface in search of nutrients and moisture. On the hottest days direct sunlight will burn the foliage but new leaves quickly appear.

Other than root rot the biggest enemy to Clivias has to be the mealybug. This pest finds a perfect environment deep within the leaf axils where it is moist and dark. Mealybugs feed on the new emerging growth, causing stunted leaves and eventually halting growth. I have never lost a plant to mealybug, even after they have gone undetected for a long time. However, this pest can turn a beautiful thriving specimen into a brown and white mess. Frequent rinsing of the foliage is very beneficial along with applications of insecticide when the mealybugs first appear. If they are seen on only a few plants, alcohol will do the trick. In any case, when the pests are eliminated the plants quick return to normal.

A few words about my unidentified *Clivia* species will end this brief discussion of the genus. I obtained this plant a few years ago from the now closed Oakhurst Gardens. At that time the plant was believed to be around ten years old. Some other specimens should be in circulation somewhere. There are no offsets yet. The plant is dwarf in habit, being only one foot high. It is thought that it will eventually be a little taller but not much. The dwarf habit is easily maintained if the plant is not pampered, but pampering does not result in much increase in size. At present my specimen has eight leaves with another emerging. The foliage is arranged in two ranks. Under certain light exposures these ranks will form in a single plane. When this happens the entire plant will appear to be about one inch wide when viewed from the side. The leaves are around one inch wide throughout their entire length and are rounded at the tip. The longest is about 35 cm. The outstanding quality of the dark green leaves is their stiffness. The effect is that of a narrow-leaved *Haemanthus albiflos*. The plant has not bloomed yet, and is not known to have ever bloomed. Growth is quite slow but significant change can be observed in a year. If it ever does bloom photos will be submitted. Culture is like other species. Meanwhile, I will continue to experiment with cultural techniques for Clivias and other genera.

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Plants wanted by Randell K. Bennett, 3820 Newhaven Rd., Pasadena, Calif. 91107.—I am turning to the American Plant Life Society in an attempt to locate some plants that have been hard to find in the

trade. If anyone is growing any of the following I would be appreciative in knowing:

*Eurycles sylvestris*

(*E. amboinensis*)

*Eurycles cunninghamii*

*Hymenocallis macrostephana*

*Hymenocallis littoralis* var  
*varigata*

*Clivia gardenii*

*Cyrtanthus purpureus* forma  
*albus* (Vallota)

*Eucharis*—all species except

*E. grandiflora*

*Tacca*—all species

P.S. I have a dwarf, unidentified species of *Clivia* which I would sure like to have identified. It has dark stiff leaves all under 12" in length. They are rounded at the tip, less than one inch in width and of the stiffness of *Haemanthus albiflos*. The plant is at least ten years old and was purchased several years ago from Oakhurst Gardens in Arcadia. Alice Gans did not know its true identity.

## 1974 and 1975 DAYLILY REPORTS

W. QUINN BUCK, *Chairman, Daylily Committee,*  
*26 East Camino Real, Arcadia, Calif. 91006*

### 1974 REPORT

In reflecting on the 1974 season, which was full of our usual pleasure in seeing new varieties and new seedlings, it is easy to become nostalgic and go back to the 1930's when Dr. A. B. Stout's important introductions of species and hybrids from the New York Botanical Garden were the major influence and the biggest step forward in daylily breeding. Mrs. Elizabeth Nesmith in Massachusetts and Mrs. Bright Taylor in Florida were subsequently major contributors in daylily breeding, along with Dr. Hamilton P. Traub, Wyndham Hayward, and Ralph W. Wheeler in Florida.

Orville W. Fay and Miss Edna Spalding come to mind as important influences, and then such figures as Bro. Charles Reckamp, Elmer Claar, David Hall, Hubert Fischer, Stanley E. Saxton are remembered. In the South the work of Frank Childs, W. B. MacMillan, Wm. Munson, Jr., Dr. John Lambert, Mrs. W. T. Hardy, and Robert Baker Wynne can be recalled as most outstanding.

The age of the tetraploid daylilies began in the late 1940's with the Schreiner, Buck, and Traub induced clones. The next step forward was the landmark Fay-Griesbach work about a decade later, followed quickly by such important polyploidizers and breeders of tetraploid daylilies as Dr. Virginia L. Peck, Wm. Munson, Jr., James E. Marsh, Steve Moldovan, Bro. Charles Reckamp, Nate Rudolph, Dr. Currier McEwen, Frederick M. Benzinger, Clarence Blocher, and Stanley E. Saxton.

One wonders why more introductions were never made of the Traub tetraploid seedlings grown at his first La Jolla garden. Many fine appearing seedlings presumably were not appraised as worthy of in-

troduction, but one wonders if they were completely lost and never used for breeding. Marvelous reds, pinks, lavenders, besides the more usual yellows, creams, and oranges, come to mind.

The progress in the tetraploids is quite amazing when we consider the material from which they are derived. The Marsh lavenders and purples, the Peck reds, roses, and pinks, the Reckamp melons, the Fay reds, wine, pinks, and miniatures, the Blocher reds, pinks, lavenders, and purples, the Munson strongly reblooming evergreen clones and marvelous eyed varieties, and the extraordinary Marsh lavenders and purples, already give up much to enjoy and look forward to.

Judging from very excellent slides, the 1974 season saw Dr. Peck flowering superb reds, roses, pinks, purples, and lavenders. Dr. Traub bloomed a fantastically large melon which he has named, 'Melon Supreme' (Traub). Jim Marsh named two additional super lavenders. George Lenington selected some outstanding new clones for future release, and he used treated forms of 'White Formal' and 'So Lovely' for his breeding work. Bill Munson named a number of marvelous eyed varieties derived from his 'Bishop's Crest'.

In the Buck garden highlights of the blooming season would include 'Dancing Shiva' (Moldovan), a round medium sized flower of a lovely smooth pink; this one must be watched to see if it has better spike and plant qualities on an established clump. 'Mary Moldovan' (Moldovan) was again pre-eminent among the melons grown, being approached only by 'Parian China' (Reckamp) and 'Ivory Marble' (Munson). 'Silent Spring' (Munson) rebloomed well and so became one of the outstanding melons.

Among the whites bloomed the treated 'Robert Way Schlumpf' (MacMillan), the treated 'White Wings' (MacMillan), and treated 'White Frost' (Gore) were outstanding. The new diploid 'Serene Madonna' (Childs) was extremely white and very smooth in texture on a first-year plant; it must be polyploidized for use in breeding.

'Cherry Cheeks', 'Jock Randall', 'Cherry Chin' (Peck); 'Domani', 'Queen's Grace', 'Secret Garden' (Munson); and 'Chicago Silky' (Marsh) were again most outstanding among pinks and roses. 'Wine Bold' (Peck) was the clearest, most sunfast of this color. 'Douglas Dale', 'Jolly Pinder', 'Lusty Lealand' (Peck); 'Johnny Ward' (Fay), and the treated 'Shining Plumage' (Hall) were outstanding reds for quality or performance. 'Capt. Reid' (Traub) is still an evergreen red worthy of use in the South.

The new 'Irish Ice' (Reckamp) seems to be a real addition to the greenish yellows, the finest of which should include 'Irish Limerick', 'Erin Prairie' (Fay); 'Galena Moon' (Blocher). In the Buck garden 'Mary Todd' (Fay) is still the best performer in its color.

Treated 'Tai Pan' (Moldovan) was most prodigal in bloom, and the treated 'Fuchsia Flame' (Hardy) was electric in brilliance of color. 'Chicago Two Bits', 'Chicago Thistle', 'Chicago Lavender Lace' and 'Chicago Frost', four outstanding introductions from James E. Marsh, were extraordinary improvements over the early lavenders and purples

such as 'Royal Favor' (Taylor-1959) and 'Miss Jessie' (Hardy-1956), which at that time were quite advanced. The Buck seedlings out of treated 'Little Wart' (Spalding) gave an amazing range of delightful miniatures; one lavender and cream bicolor was quite superior, several clones were of a distinct lavender blue, and a good performer was pale pink with faint eye. These will be watched most carefully as the beginning of an important line of tetraploid miniatures. Among the large flowered tetraploid seedling there were some very handsome pinks, corals, reds, and purples.

Among important new developments in daylily breeding is the lengthening of the flowering season of individual clones, as seen in the work of Wm. R. Munson, Jr., whose 'King's Cloak' has been the progenitor of many repeat-blooming evergreen clones which retain much of its capacity for sending up new spikes in secession. The Munson selections have been chosen carefully for good branching, healthy vigor, plant habit, and color, and line breeding has given a whole series of marvelous clones, most of them evergreen. Line breeding is responsible for the superior results in the Fay and Blocher seedlings, as well as in the Peck, Childs, Reckamp, and Benzinger work.

An optimistic outlook for future developments in the daylily seems assured. Interest is being sustained in the older daylily areas of the country, and it seems finally to be gaining in the West. New and important breeders and researchers are appearing all over the country. Let us hope that the daylilies can go forward in spite of social upheavals and problems.

#### 1975 REPORT

The weather during 1975 again was a powerful and unpredictable control over season and performance of our daylilies. The West had a cool, and late, season while the South had a fairly normal succession of flowering. The Midwest in some areas was quite dry, resulting in very few flowers for the National Convention in July of the American Hemerocallis Society in Avon, Ohio.

Southern California's daylilies began blooming so late that there were fewer to choose from for exhibition at the Southern California Hemerocallis and Amaryllis Society's annual Daylily Show at Descanso Gardens on June 8th, but a fine display was achieved with the material available. The show of the Southwest Hemerocallis Society in Escondido, California, on June 14th was filled with fine named varieties and many beautiful seedlings from its members.

Among yellow varieties observed in the Buck garden this year 'Mary Todd' (Fay) was still a best performer, being joined by Dr. Peck's 'Florence Byrd' and 'Royal Kin' and the Fay 'Irish Limerick' and 'Erin Prairie'. 'Yellow Crystal' (Griesbach) was a large, tall yellow of great substance, but the paler 'Galena Moon' (Blocher) had better branching, shape, and fertility. Treated 'Beth Standard' (Standard) was very fine and seemed to offer much for breeding. 'White Wings' (MacMillan), 'Robert Way Schlumpf' (MacMillan), and 'White

Frost' (Gore), in treated forms, were great additions to breeding material. 'Bengaleer' (Peck) was a wonderfully branched yellow-orange, but it faded badly. Better sunfastness was seen in 'Golden Prize' (Peck).

'Mary Moldovan' (Moldovan) was still the best melon grown, its only fault being that it is too slow of increase. The treated 'Frances Fay' (Fay) again produced a marvelous show of flowers and set many pods. The new 'Chief Sequoia' and 'Terra' (Fay) were huge low-growing melons of great quality. 'Seed Setter' (Hardy) had many spikes and set pods readily. 'Harvy Randall' (Fay) is still an exceptionally well branched pale yellow melon, and it was better than 'Cream Sachet' (Reckamp), which is of later introduction and of very similar color. 'Ivory Marble' (Munson) and 'Parian China' (Reckamp) both had tremendous substance and fine shape, making them desirable as parents.

'Dancing Shiva' (Moldovan) in its second year had perhaps the most beautiful flowers of any of the pinks grown, but it was weak on performance. 'Pink China' (Hardy) was again an excellent performer. 'Shell Pink' (Fay) made an unbelievable showing and was better than it had ever been. 'Tetra Pink Lightning' (Hall-Lachman) was a wonderful addition to breeding material.

'Cherry Cheeks' (Peck) was still the most beautiful dark rose pink grown; clear, clean color was also shown by 'Domani' (Munson). 'Jock Randall' (Peck) unquestionably was the best rose colored variety grown, but treated 'Beauty Bright' (Lester) may lead to roses of equal color quality. 'Cherry Chin' (Peck) is very lovely in its deep rose color, but it is deficient in shape. 'Wine Bold' (Peck), 'Bold Baron' (Peck) and 'Embassy' (Munson) are good wine colors, but the latter faded badly here. 'Fantastic Dream' (Brown) was a disappointing wine color of good shape; we are hoping for improvement in both color and performance in an established clump.

Among the lavenders and purples grown, all of the Marsh introductions were excellent; 'Chicago Two Bits' was the largest and clearest in color, while 'Chicago Thistle' was by far the best performer and best pod setter; 'Chicago Regal' was amazingly better than ever before. 'Aberdeen', 'Helen Boehm', and 'Cloverdale' were three of Dr. Peck's new 'Catherine Woodberry' hybrids that were most delightful. 'Northbrook Wine' (Fay) was a clear lavender-purple of low height; it should be very useful for breeding. An induced tetraploid form of 'Silver Shadows' (Munson) was a strange clear lavender over a pale yellow-green ground, and it will be used in breeding.

Among the reds best performers were the Peck varieties 'Sir Patrick Spens', 'Lusty Lealand', and 'Douglas Dale'. 'Johnny Ward' (Fay) is a vigorous low growing red that should be widely used. The taller Griesbach reds 'Gypsy Trail' and 'Joey Langdon' were excellent performers.

The most exciting eyed varieties grown were 'Bishops Crest' (Munson), a lavender pink with purple eye that reblooms wonderfully; and 'Tetra Borgia', an induced form of the well known Robert Baker Wynne

'Borgia', which produced such a fantastic range of colors in the Wynne seedlings.

The best miniatures grown were the offspring of treated 'Little Wart' (Spalding); these ranged from pale pink to dark lavender purple. Treated 'Little Emily' (Hardy), a tall, many flowered yellow, and the treated 'Double Pace' (Wynne), a bronzy red double multiflora, were two others that carried many seed pods from tetraploid crosses.

Other Buck seedlings that got special attention in 1975 were several eyed ones out of 'Jock Randall', and some excellent pinks and roses.

1975 gave much pleasure to the true daylily aficionados.

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## U. S. DEPARTMENT OF AGRICULTURE RELOCATES ITS PLANT PERMIT OFFICE

WASHINGTON, Oct. 1—Travelers or importers wishing to bring foreign plants, soil, or plant products (fruit or vegetables) into the United States now must send their applications for federal permits to a new address.

After 30 years in Hoboken, N. J., the five-person permit-issuing office of the U.S. Department of Agriculture (USDA) has moved to Hyattsville, Md. The move consolidates manpower and record-keeping at Hyattsville.

James O. Lee, deputy administrator of USDA's Animal and Plant Health Inspection Service, explained that permits are required under federal regulations designed to protect America's plant life from destructive foreign plant insects and diseases.

"To prevent loss of their property at U.S. ports of entry, persons intending to import soil and plant products should find out in advance whether a permit is required, and the other conditions of entry," Mr. Lee cautioned.

For information and permits, write to: Permit Unit; U. S. Dept. of Agric., APHIS, PPQ; Federal Building, Rm. 638; Hyattsville, Md. 20782.

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## AMARYLLIS VIRUS-RESISTANCE INVESTIGATION

WILLIAM D. BELL, *Miami, Florida*

Viruses of *Amaryllis* are problems, but there may be a solution if we can find resistance to viral infection. Unfortunately, there is currently no easy cure except to isolate healthy amaryllis from infected plants. However, remission of the visible virus symptoms can occur to some extent under varied cultural conditions, and proving virus absence often requires examination with an electron microscope and/or other means. There is strong evidence that seed-grown plants are

virus-free, and the disease unusually does not appear to infect plants in their native habitats, unless exposed to diseased cultivated plants.

Virus resistance has been found in other plants with problems similar to amaryllis. Thus, it seems reasonable that among the many species in the genus *Amaryllis*, there may be some which have a natural resistance. So we ask for help in obtaining seeds of *Amaryllis* species or species hybrids from diverse locations. *Seeds, but not bulbs or offsets*, are also of interest from hybrids which do not display virus symptoms when grown among infected plants. Floral type or quality is not of importance at this point. It is necessary to limit this request to seeds since plants will be started in an isolated plot and growing plants might introduce one or more viruses into the test plants.

Dr. F. W. Zettler is a plant pathologist at the University of Florida, Gainesville, with a personal interest in amaryllis. He is propagating these plants at his home for eventual testing for virus susceptibility. Hopefully, this request will result in his obtaining a diverse collection of germ plasm, some of which are resistant to one or more of the amaryllis viruses. Eventually, it may be possible to incorporate this resistance through selective breeding into some of the more attractive—but susceptible—cultivars of amaryllis.

Please send seeds suitable for this investigation to:

Dr. F. W. Zettler  
31 Grassy Lake Road  
Archer, Florida 32618

## GRAVEL-TOP AMARYLLIS CULTURE

RICHARD E. TISCH, 20516 Clark St.,  
Woodland Hills, Calif. 91364

Planting my *Amaryllis* bulbs in gravel-topped soil has improved their growth, reduced losses to insect damage and fungus rot, and dramatically diminished the incidence of "red spot" infestation. The net result has been better flowering: taller, stronger scapes; larger, brighter flowers; earlier maturation of bulbs; more and healthier offsets.

Simply, my latest method is the use of a layer of mixed  $\frac{3}{4}$  inch crushed gravel and pea gravel, under and around the bulbs, whose roots are down into a standard *Amaryllis* soil mix. It works equally well in pots or in outdoor beds. All my potted plants have now been converted to this system, which started out as a desperate measure in my "sick bay" in the screenhouse. It came as a result of hauling out and rereading back copies of PLANT LIFE.

—When I had some plants which were steadily declining, I spent many hours going back through my records to see if there was a clue in my notes! None! Then, as is my custom, I thumbed through my PLANT LIFE volumes. Gradually there came to me a concept of the natural conditions under which so many collectors have found *Amaryllis* growing in their native habitat. Frequently it was implied,

and sometimes specifically stated that they were found growing in a loose "screed" type fall-off from rocky structure, with their roots in the rich humous that had accumulated as rains washed down through the loose topping. In some cases it was mentioned that they grew on rocky ledges, in the debris which had gathered there over the years.

My first patient was a prized *A. belladonna*, collected in Peru and graciously sent to me by the collector. It had arrived with an exceptionally extensive root mass growing from large strong bulbs. It had flourished and flowered repeatedly for two years, then had suddenly shown a noticeable decline in leaf growth and had stopped flowering. Shortly after replanting it with gravel under and around the bulb it reacted favorably and started growing and flowering again in its characteristic happy fashion. So, with renewed faith as a healer of sorts, I looked around for more patients. They were readily at hand, and numerous.

I went through all the potted seedlings and specimen plants on the screenhouse benches, and then took on the outdoor beds—save one, which was used as the test bed. Sure enough, that unchanged bed was the one which had much red spot, with twisted scapes that never brought their flowers to blossom, and with mushy bulbs which dwindled away into complete disappearance. The other beds put on a show which was an almost startling advance over that of previous years.

These successes have led me into trying the same planting scheme on other Amaryllids. My *Sprekelia* have been first, being mostly in pots and tubs so that they can be brought inside to more warmth during the winter cold stretches. They are flowering now, one after another, with larger, brighter blooms. This is the one thing I do not understand: why are most of the flowers noticeably larger and brighter in color? Regardless of the reason, I am now getting ready to replant the "test" bed bulbs in this same manner, to see if they change for the better. More bulbs will be put in oversized pots and in tubs; these seemed to show the greatest improvement over bulbs planted in pots with the soil directly under and around the bulbs.

Some experimental bulb plantings, in which I used only pea gravel or finer crushed rock, have not done so well. They have shown improvement, but not so marked as those plantings which used the crushed rock—pea gravel combination, or which used only crushed rock. Parallel to this, there were some experimental plantings of bulb cuttings and seedling bulbs directly into gravel only, with no soil underneath, watering them with hydroponic growing solution. These prospered, but did not show enough difference to warrant expansion of the use of that method, or even continuation of its use on the experimental plants. Since having replanted in gravel with their roots in soil, they look and act just as happy.

I must conclude, therefore, that planting *Amaryllis* bulbs with their roots in soil, but with gravel under the bulb and around it, results in superior plant growth.

**PLANT LIFE LIBRARY**—continued from page 92.

into the wonders of plant growth. The author presents 20 additional projects for children, and she is to be complimented for her foresight since the dividends from such early contact with living things will direct the energies of the child in the right direction for a proper regard for all living things. Such a child would naturally be interested in nature and its energies could easily be guided into the proper channels. Every household with children should have a copy of this book. The wholesome dividends from it are incalculable. Very highly recommended.

**NATURE, CHILDREN AND YOU**, by Paul E. Goff. Exposition Press, 900 So. Oyster Bay Rd., Hicksville, N. Y. 11801. 1974. The author explains why he became a naturalist, and points out that nature interpretation is common sense. He lists a great many projects that could be brought to the attention of children and thus to direct their energies to nature appreciation, including the life cycle of the forest, mounds in the woods, craters in the forest floor, how a tree grows, the log as a recycling station, squeezing dead wood, the skin of a tree, hollow trees, a tree as an apartment house, etc., etc., etc. This is another book which should be in the home with growing children so that the parents may direct the energies of their offspring toward nature appreciation. Very highly recommended.

**MARINE AQUARIUM FISH IDENTIFIER**, by Wilbert Neugebauer, and edited by Braz Walker. Sterling Publ. Co., 419 Park Av., New York 10016. New trade edition, 1975. Pp. 256. Illus. \$4.95.—Originally written by Wilbert Neugebauer in Stuttgart, Germany, 20 years ago, translated by Manly Banister, and adapted by Braz Walker, a Texan and authority on tropical fishes, this attractive text should appeal to those interested in salt water fishes. Following the brief introduction, glossary and black-and-white illustrations of the general marine fish groups, twenty-seven species are illustrated in color, and described. For each species illustrated, the family, scientific and popular names are given; the distribution and habitat are indicated, and the species is described; the length is noted and brief comments made. Scientific name and general indices complete the volume. Recommended for all interested in marine fishes.

**THE SIAMESE FIGHTING FISH: ITS LIFE CYCLE**, by William White, Jr. Sterling Publ. Co., 419 Park Av. So., New York 10016. 1975. Pp. 60. Illus. \$5.95.—Subtitled "Betta and Paradise Fish", this attractive book, profusely illustrated in color, is of especial interest for these fishes show an intermediate evolutionary stage from fishes to land animals. They not only use gills to rake oxygen from water, but also have an accessory breathing organ or "labyrinth" which allows them to surface and take in atmospheric oxygen directly. The four sections of the book are devoted to the anatomy, behavior, breeding and ecology of these unusual fishes. The index completes the volume. Highly recommended to all interested in biology.

**FLOWERS OF THE MOUNTAIN COUNTRY**, by Stanley L. Welsh and Bill Ratcliffe. Brigham Young University Press, Provo, Utah 84602. 1975. Pp. i-xx + 83. Illus. cloth, \$8.95; paperback, \$5.95.—This "representative sampling" of the mountain wild flowers of the western United States and Canada includes no less than 118 breath-takingly beautiful color plates. These alone are worth more than the price of the book. After the **introductory** sections on using the book, and a survey of **Mountain Country**, with beautiful scenes in color, the rest of the book with many colorful illustrations is divided into four parts, according to colors; which is to simplify identifying collected flowers: Part 1, flowers white; Part 2, flowers pink, to red; Part 3, flowers yellow to orange; and Part 4, flowers blue to purple. An index completes the volume. Very highly recommended to all for there is surely none who would not be thrilled with the utterly beautiful wild flowers.

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Fig. 24. *Miersia chilensis* Lindl. 1. the entire plant; 2. cross-section of leaf, 3. flower, 4. ligules, 5. ovary with ligules and stamens, 6. cross-section of ovary, and 7. stamens.

**MIERSIA CHILENSIS LINDLEY**

CONSUELO DEL POSO AND OTTO ZOELLNER,  
*Catholic University, Valparaiso, Chile*

The climate of Central Chile is characterized by its rainy winters and dry summers and these are the conditions which Amaryllidaceae prefer for growing and flowering. So in Spring time the Chilean



Fig. 25. Mitotic metaphase chromosomes from root-tip cell of **Miersia chilensis**,  $2n=12$ . **Upper, and lower left**, one squashed cell showing the 12 chromosomes. **Lower right**, types of chromosomes, **m**, metacentric, **s**, sub-metacentric, and **t**, telocentric. Note in extreme upper left corner that the engraver has cut off tips of one **t**. chromosome. For whole chromosome see t-1 in lower right corner.

mountains, hills and plains are in flame with the flowers of many bulbous plants: the brilliant red Rhodophialas and Phycellas, the red striped Placeas, the white Nothoscordum, Leucocoryne and Chrysocoryne, the greenish purple Tristagma and many more.

But there is one tribe of Amaryllid plants, very different from all of these mentioned above, it is the Tribe Gilliesieae. The specimens of these monotypical Chilean plants may never awake interest in gardeners and plant-lovers in cultivating them, nor may the representatives of Gilliesieae ever be seen in flower expositions. These little plants are small, modest, they flower in the earliest days of Spring (*Miersia* can be found at the beginning of winter season). They prefer shadowy places and their small flowers have green tepalsegs. Only a watchful observer will discover these small, generally zygomorphic flowers between tall green grasses and leaves.

#### DESCRIPTION OF **MIERSIA CHILENSIS** LINDLEY, FIG. 24

*Bulb* small, tunicated formed like a pear, 1.6—1.8 cm high, 1—1.3 cm wide. Aerial parts of plant 15 - 20 cm high, with 3 or 4 leaves, leaves bright green, linear nerves, contemporaneous with flowers. *Scape* cylindric, from 7—16 cm high. Spathe 2-valved, lanceolate greenish. Umbel with 4 or 5 flowers, pedicels subequal. *Flowers* with 6 green tepalsegs (3+3), setepalsegs lanceolated 0.8—1 cm long and 0.2 cm wide. The petepalsegs 0.6—0.8 cm long and 0.15 cm wide. *Stamens*, 6 their filaments joined, forming a staminal tube which surrounds the ovary. *Ligules* (or paraperigone) 6 very small scales inserted on the side of the *staminal tube*, bifid, 3 mm long, 0.5 mm wide, ligules purple coloured. *Style*, short, 2 mm long, *stigma* capitate.

*Miersia chilensis* flowers from June till August; during the winter months. It grows in shadowy places, the plants always stand in thick groups of 10—50 bulbs. Carlos Reiche who studied this group of alliaceous plants wrote that *Miersia* is self-pollinated because the flowers appear in cold rainy wintertime and grow only in shadowy places where no insect will look for them. They are odorless and of greenish color and in no way attractive. *Miersia* develops ripe fruits and seeds, but plants multiply also vegetatively.

***Miersia chilensis*** Lindley,  $2n=12$  chromosomes. Fig. 25

The caryotype of *Miersia chilensis* is as follows:

- 4 pairs, *m*, metacentric
- 1 pair, *s*, submetacentric
- 1 pair, *t*, telocentric

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The bulbs used in this investigation were collected in the valley of Marga-Marga, Province Valparaiso, Chile, in June 1973, and the entire plant was dried and preserved in the Herbarium of the Catholic University of Valparaiso as a voucher specimen.

**MIERSIA CHILENSIS**—Poso & Zoellner, continued on page 57.

**Leucocrinum montanum** Nuttall

L. S. HANNIBAL, 4008 Villa Court,  
Fair Oaks, California 95628

L. H. Bailey in his *Cyclopedia of Horticulture* describes *Leucocrinum montanum* as a possible garden bulb and lists the source as western United States. Inquiries by the writer some thirty years back brought vague replies concerning the plant or its habitat. No one seemed to know it. Thus when we first encountered the plant in flower along a little traveled dirt road in the subalpine desert area well east of Mount Lassen, California, I failed to recognize it. Obviously the snow white blossoms growing near flush with the ground were



Fig. 26. **Leucocrinum montanum** Nuttall, 15 miles north of Eagle Lake, California. **Left**, a single clump; **right**, showing natural spacing (see text).

Liliaceous in form, but the plant lacked an enlarged bulb, had a fibrous root system and bore blossoms with inferior ovaries whose pedicels came directly from the basal plate. There was no scape or umbel. Was it *Amaryllidaceae* or what?

I took several samples to key the plant out. According to W. L. Jepsen's *Flowering Plants of California* it was *Leucocrinum montanum* but Jepsen, Munz and Bailey all indicated it was Liliaceous while J. Hutchinson suggested borderline. No references mentioned the inferior ovaries to the blossoms or that the flower buds emerged from the basal plate. Did it actually have an umbel imbedded in the basal plate?

How could it relate to *Hemerocallis* or *Hesperocallis*? How rare was it and could it be grown in the garden or not?

I needed more material and some idea of its growth habits and requirements, but it was several years before I could return to the area where I first found the plant ten miles north and north-west of Eagle Lake in Lassen County. To find the flowers out in their prime one had to be there shortly after the snow was off the ground, preferably in mid May. June would be too late. In Harvey Valley, Little Harvey Valley and the Champs Flat area the plants cover hundreds of acres of open level meadow land. The bulbs seem to prefer a loamy volcanic soil which has been loosened by frost heave. Usually the water table, developed by melting snow, is less than two feet below the roots. Normally dwarf sage and other alpine plants are common associates, as are lava boulders and scree. Plant densities often reached 20 or more plants to a square meter. The spacing is unusually uniform as no plants grow with overlapping root systems. The greatest population densities were found at 6200 feet elevation, none were found below 5500 feet.

As stated, the plants have no apparent bulb. The ten to twenty short linear leaves are completely sheathed below ground level and this sheathing terminates at the basal plate some two to three inches down. The radial root system spreads horizontally forming a circle five to eight inches in diameter. Cattle or deer will not touch the plants. The blossoms flower without a trace of a scape; the pedicels and bracts arise as a cluster directly from the basal plate. All are well enclosed within the older leaf bundle. By removing the latter one finds the pedicels ranging from 2 to 20 mm. in length, depending upon the age of the blossom. The ovary is inferior and the major portion of the tepal tube is also enclosed within the leaf sheathing. Obviously, as the seed ripen the pedicels elongate such that the seed can scatter on the ground. Plant increase also occurs by bulb splitting and offsets, but once detached they seem to be exterminated by the parent plant.

Apparently few botanists get to see *L. montanum* since it flowers three or four weeks after the snow is off these subalpine meadows. Attempts to grow the plants at lower elevations, even in their own soil has been unsuccessful. They have a very restrictive ecological zone which appears to lie along the extreme eastern fringe of the *Pinus ponderosa* belt. They require full sun, a loose, moist, slightly alkaline, volcanic soil, a 6500 foot elevation with freezing winters and cold nights, and a ground water level only a few inches below the roots. In no instance were plants found on sloping ground more than a foot or two above a ditch or stream. *The plant's toxic enzymes kill all grasses, sages and other competing plants.* Some variability was noted in flower size and tepal width. Colonies reported in the adjacent counties of Modoc, Sierra and Siskiyou have not been checked out, but these colonies north of Eagle Lake do not extend over a width greater than ten miles and definitely not east of Highway 395 since the California-Nevada desert is too dry in this portion. The plant has been reported as growing about the Rocky Mountains (Marriage, 1941) and eastward into Nebraska where Nuttall found it in 1810.

From the evolutionary standpoint the *Leucocrinum* is quite unique and extremely primitive. Its inferior ovary suggests that this feature predates the formation of a scape or umbel. We therefore have difficulty associating it with *Hemerocallis* or other genera having superior ovaries. All features point up a strict adaptation for subalpine conditions. In some respects *Leucocrinum* resembles *Romulea nivilis* on Mt. Hermon in Israel but only by parallel evolutionary development due to similar climates and exposure. *Leucocrinum*'s winter hardiness can only be approached by *Narcissus* and a few Andean bulbs. We can only surmise that *Leucocrinum*'s preservation through the ages has been its ability to retain its territorial areas against competing plants by its toxic enzymes. Its great age is also borne out by it being found in the eastern Rocky Mountain area as well as north-eastern California with no known colonies between. Distribution under such restricted ecological requirements probably predates the more recent ice ages. One has to see the plants growing in the wild to appreciate how exacting its requirements are or how effective its enzymes are in preserving its territorial imperative status. Under the circumstances it is not a potential garden bulb and M. Cave's work shows that *Leucocrinum* is quite *remotely* related to both *Hesperocallis* and *Hemerocallis*.

We wish to thank Dr. J. Madison, University of California at Davis for his comments concerning the Alpine hemicryptophytic features exhibited by *L. montanum*. In his opinion the inferior ovary does not necessarily indicate close relationship with the *Amaryllidaceae* either.

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### SAPONINS DOUBTFUL IN *LEUCOCRINUM MONTANUM*

Hamilton P. Traub

In early July 1975, Mr. L. S. Hannibal of Fair Oaks, Calif., kindly sent samples of *Leucocrinum montanum* (past the flowering stage), collected in Lassen County, Calif.

The descriptions of this plant in the literature are incomplete in

some of the characters and it is for this reason that these are recorded here: The leaves were no longer in prime condition, but the seed capsules at the base of the leaves had ripened which made it possible to describe these: fruit a trilocular whitish capsule, approx. 7 mm. long, 5 mm. in diam. The seeds did not set equally in the locules, ranging from 1-1-0, 1-1-1, 2-1-1, 2-2-1, 3-1-0 and 3-1-1. They were small, black, approx. 3 mm. long, 2 mm. in diam.

TEST FOR SAPONINS

The main purpose for sending the plant samples was to obtain a preliminary test for saponins. This was carried out on the leaves, not in their prime; and the roots, in their prime, according to the stable-foam test as described earlier (Traub, 1975). The results are given in Table 1.

Table 1. Testing for sterodial saponins by the stable foam method (Traub, 1975).

Species	Order	Depth, ml. stable foam <sup>1</sup>	Presence of Saponins
Beschornerea sp.	Agavales	Leaves 4.00+	positive
Amaryllis divifrancisci	Amaryllidales	Leaves 0.00	negative
Leucocrinum montanum	Liliales	Leaves <sup>2</sup> 0.25	doubtful
		Roots 1.00	doubtful

<sup>1</sup> A stable foam of 2.00 cm. or more is considered to be positive for sterodial saponins, and lesser amounts, remaining after the 5 minute interval, is considered as doubtful.  
<sup>2</sup> Not in prime condition.

Apparently a more refined method of analysis is required to determine if minor amounts of saponins are present in *Leucocrinum montanum*. This species is therefore considered as belonging in the Order Liliales pending more refined analyses.

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TRIBE GILLIESIEAE, FAMILY ALLIACEAE, ORDER ALLIALES

HAMILTON P. TRAUB

The Tribe Gilliesieae has been reviewed by Reiche (1883) who placed it under the Liliaceae. Hutchinson (1934, 1939) classed it with the Amaryllidaceae, and Traub (1963, 1970) accepted this placement. However, recent research has caused him to group it as a tribe under the Family Alliaceae in the New Order Alliales (Traub, 1972).

The writer can recall no other group of plants in which the characteristics on first examination appear so scrambled as in the Tribe Gilliesieae. The generic descriptions resemble a botanical crazy quilt. However, on closer study, a consistent evolutionary trend, from *free stamens* in *two* genera to a union of the stamen filaments below into a *staminal tube* in *seven* genera, is revealed.

Although there is evolution from *free tepals* to a union below into

a *tepaltube*, and *tepalsegs* above, and again from 6 tepals or tepalsegs to 5 or 3; from 6 to 3 or 2 fertile stamens, and from the entire to the 3-parted stigma, in some species, these are more or less secondary lines of change, and appear to be more or less random. They may or may not overlap with the two main lines of evolution within the Tribe. Other characters are of a similar nature.

The following Key (Table 1) to the subtribes and genera of the Tribe Gilliesieae, devised in 1965, is presented now in the hope that it may stimulate interested workers to publish their results on this subject.

TABLE 1. Key to Subtribes and Genera of the Tribe Gilliesieae Lindl., Family Alliaceae, Order Alliales.

TRIBE GILLIESIEAE LINDL.

1a. Flowers with **stamen-filaments free**; floral segments united below into a short **tepaltube**, with 6 **tepalsegs** above; fertile stamens 3, staminodes 3:

SUBTRIBE 1. SOLARIINAE Traub, Subtrib. nov.

- Flores filamentis staminum libris. Typus: Genus *Solaria* R. A. Phil., in *Linnaea* 29: 72. 1857.
- 2a. Leaf solitary, linear, umbel 3—4-flowered. (Chile) .....1. *Solaria*
- 2b. Leaves 3, umbel-several-flowered. (Chile) .....2. *Erinna*
- 1b. Flowers with stamen-filaments united below into a **staminal tube**:

SUBTRIBE 2. GILLIESIINAE Traub, subtrib. nov.

- Flores filamentis staminum infra in tubum staminalem connatis.  
Typus: Genus *Gilliesia* Lindl. in *Bot. Reg.* t. 992. 1826.
- 3a. Tepals or tepalsegs 6 or 5:
- 4a. Floral segments free; with or without **scales** at the base of, or adnate to, the **staminal tube**:
- 5a. Without scales at the base of the stamens or adnate to them; tepals 6, fertile stamens 6, stigma 3-lobed; umbel 1-flowered (Chile) .....3. *Speea*
- 5b. With scales at the base of, or adnate to, the staminal tube; umbel 4- or more-flowered:
- 6a. Fertile stamens 6, staminal tube oblique urn-shaped; tepals 6. (Chile) .....4. *Miersia*
- 6b. Fertile stamens 3, staminodes 3:
- 7a. Leaves very large, to 5 ft. tepalsegs 6. (Chile) .....5. *Gethyum*
- 7b. Leaves much smaller, tepalsegs 6 or 5; style trifid. (Chile) .....6. *Gilliesia*
- 4b. Floral segments united below into a campanulate tepaltube 6 tepalsegs above; fertile stamens 2; staminode (filament only) 1; umbel several-flowered. (Chile) ....7. *Ancrumia*
- 3b. Tepalsegs 3, free or nearly so; umbel 1—5-flowered:
- 8a. Tepalsegs entirely free; fertile stamens 6; style entire; umbel 1—2-flowered. (Argentina) .....8. *Schickendantziella*
- 8b. Tepalsegs nearly free, staminal tube irregularly split above into 6 lobes, usually only 3 lobes bearing anthers; stigma 3-ligulate; umbel 5-flowered. (Peru) .....9. *Trichlora*

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West Germany. 1970.

Traub, Hamilton P. The Order Alliales. *Plant Life* 28: 129-138. 1972.

## PLANT LIFE LIBRARY

**IN CHINA'S BORDER PROVINCES—THE TURBULENT CAREER OF JOSEPH ROCK BOTANIST-EXPLORER**, by S. B. Sutton. Hastings House, Publishers, New York. 1974. 334# pp., illus. \$9.95. Botanical explorers, like surfers, and other rugged individualists are a different breed of cats from their conventional fellows in our Society. If anyone doubts this statement he should read Sutton's biography of Joseph Rock. As depicted by Sutton, Rock emerges as a unique but fascinating character with a great diversity of interests and an insatiable ego. Rock is well known in botanical circles for his work as a collector in China and Tibet. He made a number of trips to these areas from about 1920 until 1949. As a botanical collector, he never achieved the status of such well known figures as E. H. Wilson, Kingdon Ward, Fortune, Douglas, and others; much to his disgust. However, his knowledge of, and feeling for, the obscure native tribes that inhabit the little known borders of China and Tibet has never been excelled. At his death, he left a quantity of diaries, reports, letters, and an unpublished manuscript. By skillfully combining these materials along with interviews of several of Rock's relatives and contemporaries, Sutton has given us an interesting biography of one of the most unique botanists of our time. His explorations were financed by the National Geographic Society, the Arnold Arboretum of Harvard University, the U. S. Department of Agriculture, the U. S. Natural History Museum, and his own resources.

This book was a disappointment to me, because it barely touches on the botany of the regions explored by Rock, nor does it even assess or mention the importance of Rock's horticultural contributions to our homes and gardens. Perhaps Sutton is reserving an account of Rock's botanical exploits for a future book, we hope so.—**Thomas W. Whitaker.**

**A FIFTH SUMMARY OF THE VERBENACEAE, AVENNIACEAE, STILBACEAE, DICRASTYLIDACEAE, STYMPHOREMACEAE, NYCTANTHANACEAE, AND ERIOCAULACEAE OF THE WORLD AS TO VALID TAXA, GEOGRAPHIC DISTRIBUTION, AND SYNONYMY.** 2 vols. by Harold N. Moldenke. Publ. by the author, Dept. of Biol. Sciences, William Paterson College of New Jersey, Wayne, N. J. 07470. Copyright 1971. Pp. 974. Paper bound.

This fifth summary of the *Verbenaceae* and related families by Dr. Moldenke ranks among the monumental research projects in the field of taxonomy. The text is concerned with the geographic distribution; alphabetical lists of rejected and accepted names; a tentative dichotomous key to the families and other categories above the species level; rejected and doubtful records; a masterful statement of policies; an index of the habitat countries, Islands, etc. of the species and the subspecific entities; and an index of families, genera, species and subspecific entities. The volumes close with a statistical summary of names considered: 119 family and generic names, 5,146 specific and intraspecific names, 248 group names accepted, and 15,240 rejected names. A total of 20,753 names accounted for. Very highly recommended to all taxonomists.

**SMITHSONIAN CONTRIBUTIONS TO BOTANY.** In this numbered serial publication the Institution publishes original monographs dealing with various plant groups, which may be obtained from the Smithsonian Institution Press, Washington, D. C. 20402. **No. 18. THE GENUS APHELANDRA (ACANTHACEAE)**, by Dieter C. Wasshausen. Pp. 157, 56 figures. 1975.—The history, palnology, and phytochemistry, of this group are considered. The genus *Aphelandra* and the 165 species are described in

detail. **No. 19. THE GENUS THRINAX (PALMAE: CORYPHOIDEAE)**, by Robert W. Read. Pp. 98, 58 figures. 1975.—The history of the genus, the distribution and ecology, morphology, anatomy, cytology, and breeding behavior of these plants is considered. The Genus *Thrinax* and its four species are described in detail. **No. 20. FLORA MICRONESIA, 1: GYM-NOSPERMAE**, by F. Raymond Fosberg and Marie-Helene Sachet. Pp. 15, 1 figure. 1975.—The scope and plan of the Flora is briefly outlined. Floristic taxonomic treatments, with keys, synonymy, descriptions, distribution, ethnobotany, etc., are provided for **Cycadaceae, Araucariaceae, Podocarpaceae, Pinaceae, Taxodiaceae, Cupressaceae and Gnetaceae**. **No. 21. POLY-NESIAN PLANT STUDIES 1-5**, by F. Raymond Fosberg and Marie-Helene Sachet. Pp. 25. 1975. In this pamphlet systematic, nomenclatural and distributional observations on various genera of Polynesian vascular plants, indigenous and exotic, and new species, varieties and nomenclatural combinations are recorded. **No. 24. FLORA MICRONESIA, 2: CASUARINACEAE, PIPERACEAE, AND MYRICACEAE**, by F. Raymond Fosberg and Marie-Helene Sachet. Pp. 28, 1 figure. 1975.—Gives systematic treatments, including descriptions, synonymy, pertinent literature references, keys, ethnobotany, citations, geographic records, and pertinent literature examined, of the families under study. **No. 26. A MONOGRAPH OF THE LICHEN GENUS RELICINA (PARMELIACEAE)**, by Mason E. Hale, Jr. Pp. 32, 16 figures. 1975. A revision on the world level is presented for 24 species of *Relicina*, including 4 new species. **No. 28. A MONOGRAPH OF THE GENUS EPERUA (LEGUMINOSAE: CAESALPINIOIDEAE)**, by Richard S. Cowan. Pp. 45, 13 figures. 1975.—A monographic treatment of the Genus *Eperua*, consisting of 18 species of which 4 are described as new. The gross morphology, leaf epidermis anatomy and palnology of most of the species are presented for the first time. These outstanding contributions are very highly recommended to all interested in plants.

**COCONUTS**, 2nd edition, by Reginald Child. Longmans, London. 1974. Imported by Humanities Press, Atlantic Highlands, N. J. 07716. Pp. 335. Illus. \$30.00.—In this second edition of an outstanding text on coconuts, the subject is brought up to date after the lapse of a decade. After the consideration of the historical background and world areas and production, the botany of the plant and varieties, the text is concerned with climate and soils, selection and breeding, plantation establishment and care, nutrition and fertilizers, cultivation and maintenance, insect pests and diseases, the crop, and its commercial products, and research and information. Very highly recommended to botanists and those interested in the production of coconuts.

**BIOLOGICAL SYSTEMATICS**, by Herbert H. Ross. Addison-Wesley Publ. Co., Reading, Mass. 01867. 1974. Pp. 345. Illus.—It is refreshing to note that the aim of the author is to present the theory and practice of systematics simply and clearly. The author uses examples from animals, plants and bacteria whenever possible to give the student a well-rounded introduction to the subject. The subjects covered include a history of systematics, scientific interpretation, material basis of systematics, scientific reasoning, speciation, interpretation of living species, phylogeny, dispersal, ecological diversification, classification, and the future of systematics. A brief over-all modern classification of Superkingdom **Accellularae**: viruses, and Superkingdom **Cellularae**: Kingdom **Procaryotae**—Blue Green Algae and other autotrophic procaryotes and bacteria, and Kingdom **Eucaryotae**, plants, fungi and animals, should be added to the text. Very highly recommended to beginning students in biological systematics.

**FLORA OF THE TEXAS COASTAL BEND**, by Fred B. Jones. Rob & Bessie Welder Wildlife Foundation, P. O. Drawer 1400, Sinton, Texas 78387. 1975. Pp. i-xxxvi + 262. Illus.—This attractive book on the Flora of the Texas Coastal Bend is a pioneer guide to the wild flowers, shrubs, trees, vines and other wild plants within a radius of 30-60 miles of Corpus Christi, Texas. The introduction is concerned mainly with the using of

keys, the soils, climate, etc. of the region. This is followed by keys to the families, genera, and species, a listing, family by family, of all the native species (except grasses) with descriptions, preferred habitats, frequencies of occurrence and flowering periods. Highly recommended to outdoor nature lovers, conservationists, biology students, professional and amateur naturalists, park and wild life enthusiasts, agriculturalists and gardeners.

**(THE FERNS OF JAPAN) ENUMERATIO PTERIDOPHYTARUM JAPONICUM: FILICALES**, by Toshiyuki Nakaike. University of Tokyo Press. Imported by International Scholarly Book Services, P. O. Box 4347, Portland, Oregon. 1975. Pp. i-xiii + 375. \$29.50.—Although the identification and classification of the ferns of Japan had been completed by previous workers, the descriptions are often imperfect, and thus the purpose of this attractive book is to clarify the taxonomic status, their nomenclature, geographical distribution, and history of research activities on each taxon. The ferns included are confined to the **Leptosporangiopsida**, and the geographical area concerned includes all the islands of Japan. Highly recommended to all interested in the ferns.

**CONTROLLED ENVIRONMENT FOR PLANT RESEARCH**, by Robert Jack Downs. Columbia University Press, 562 W. 113th St., New York 10025. 1975. Pp. (i-ix) + 175. Illus. \$12.00.—The purpose of this timely book is "to describe the mechanical and biological system controlled environment facilities and to relate these systems to the problem of operation and plant growth." The subjects covered include the controlled-environment facility, conditioning systems for the major environmental parameters, environmental measurements, biological aspects of controlled-environment rooms, specifications for the plant growth chamber, and testing and maintenance of the plant-growth chamber. The useful information in five appendices and an index complete the volume. Very highly recommended to all plant scientists whose work requires the controlled-environment facility.

**PHOTOSYNTHESIS, PHOTORESPIRATION AND PLANT PRODUCTIVITY**, by Israel Zelich. Academic Press, 111 5th Av., New York 10003. 1971, 2nd edition 1973. Pp. i-xiv + 347. Illus. \$21.00.—The purpose of this outstanding book is "to provide advanced undergraduates, graduate students, teachers and research workers in a number of disciplines with a perspective of photosynthesis **and how it can be increased**." The subjects covered include the morphology of leaf cells; chloroplasts and their various activities; photochemistry and photosynthetic electron transport; biochemical pathways of CO<sub>2</sub> fixation in photosynthesis; dark respiration and photorespiration; glycolate metabolism and the mechanism of photorespiration; photosynthesis as a diffusion process; environmental and physiological control of net photosynthesis in single leaves; and relation of photosynthesis to total respiration, and other factors to control of productivity in stands. Highly recommended to all students of plant physiology.

**PLANTS IN THE LANDSCAPE**, by Philip L. Carpenter, Theodore D. Walker, and Frederick O. Lanphear. W. H. Freeman & Co., 660 Market St., San Francisco, Calif. 94104. 1975. Pp. viii + 534. Illus. \$16.00.—This most attractive volume will serve as an adequate introduction to the principles and practice of ornamental horticulture in landscape architecture. The first section is concerned with the historical perspective, and present-day landscape industry. The second and third sections are devoted to the kinds of plants used in landscape design, the principles of plant ecology, plant classification, and landscape design. The following sections are concerned with the preparation and implementation of landscape plans, landscape construction, maintaining the landscape, and integrative landscaping. Indices of plant names and subject matter complete the volume. Very highly recommended to all interested in landscaping.

**PLANT LIFE LIBRARY**—continued on page [5].

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For the roster of the general officers of the Society, the reader is referred to the inside front cover of this volume.

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[AMERICAN AMARYLLIS SOCIETY, continued from page 8.]

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1. **AMARYLLIDACEAE: TRIBE AMARYLLEAE**, by Traub & Moldenke (including the genera *Amaryllis*, *Lycoris*, *Worsleya*, *Lepidopharynx*, *Placea*, *Griffinia*, and *Ungernia*; Manila covers; 194 pages, incl. 18 illustrations. \$5.00 postpaid.

This is required reading for every amaryllid enthusiast.

2. **DESCRIPTIVE CATALOG OF HEMEROCALLIS CLONES, 1893—1948**, by Norton, Stuntz, and Ballard. A total of 2695 *Hemerocallis* clones are included and also an interesting foreword, and explanatory section about naming daylilies. Manila covers; 100 pages (1—X; 1—90), includes a portrait of George Yeld. \$5.00 postpaid.

**3. THE GENERA OF AMARYLLIDACEAE**, by Hamilton P. Traub. Includes a general introduction, a key to the subfamilies, infrafamilies, tribes, subtribes and genera of the Amaryllidaceae, and descriptions of all the genera. Every member of the Society should have this book for constant reference. Manila covers; publ. 1963; 85 pages. \$7.00 postpaid.

**4. LINEAGICS**, by Hamilton P. Traub. This is the first outline text for the undergraduate student on the grouping of organisms into lineages. The text is divided into four parts: (a) the history of lineagics and lineagics as an integrated science; (b) basic lineagics, principles and procedures; (c) applied lineagics, principles and procedures; and (d) research methods in lineagics. Recommended for the student in biology. Publ. 1964. Manila covers, 163 pages, incl. 8 illus. \$7.00 postpaid.

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